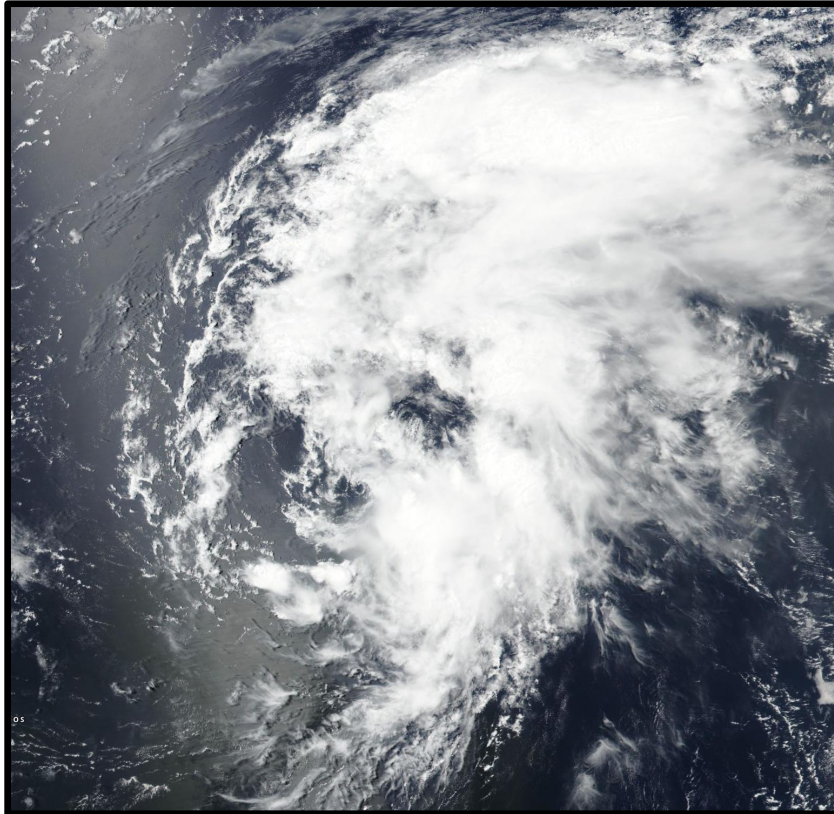# NATIONAL HURRICANE CENTER
TROPICAL CYCLONE REPORT[1]

TROPICAL STORM CINDY
(AL042023)
22-26 June 2023

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National Hurricane Center
27 July 2023

**GOES-16 GEOCOLOR IMAGE OF TROPICAL STORM CINDY AT 1800 UTC 24 JUNE 2023.
IMAGE COURTESY OF NOAA/NESDIS/STAR.**

Cindy was a relatively short-lived tropical storm over the tropical central Atlantic that did not directly impact land.

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[1] This is an abbreviated Tropical Cyclone Report since there were no coastal watches or warnings and no direct fatalities reported in association with Cindy.

Tropical Storm Cindy

22-26 JUNE 2023

BEST TRACK

The "best track[2]" positions and intensities for Cindy are listed in Table 1. The best track chart of Cindy's path is given in Fig. 1, with the wind and pressure histories along with available observations[3] shown in Figs. 2 and 3, respectively. Observations also include flight-level and stepped frequency microwave radiometer (SFMR) data from 2 flights of the U.S. Air Force Reserve Command's 53rd Weather Reconnaissance Squadron (Fig 4). These missions provided 4 center fixes for Cindy.

There were no land-based or ship reports of tropical-storm-force winds associated with Cindy.   Cindy passed very near NOAA buoy 41044 on 25 June and the buoy reported a minimum pressure of 1011 mb and maximum sustained winds of 22 kt on that day.

Origin

Cindy developed from a tropical wave that moved off the west coast of Africa on 18 June. The storm formed behind Tropical Storm Bret, both Cindy and Bret were unusually early season storms that formed in the main development region (Goldenberg and Shapiro 1996).

Peak Intensity and Minimum Pressure

Cindy's peak intensity of 50 kt from 0600 UTC to 1800 UTC 24 June is based on a blend of Dvorak estimates from TAFB, SAB, and the ADT at 0600 and 1200 UTC that day. The satellite estimates ranged from 45 to 65 kt during that time period. Data from the Air Force Reserve Hurricane Hunters around 1800 UTC 24 June also supported the 50-kt intensity. The aircraft reported maximum 850-mb flight-level winds of 59 kt, which converts to 47 kt at the surface, and maximum SFMR winds of 48 kt at that same time.

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[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.

[3] Observations include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB), 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 Cindy.

The minimum central pressure of 1004 mb is based on a blend of the Knaff-Zehr-Courtney pressure wind relationship and data collected by the Air Force Reserve Hurricane Hunters around 1800 UTC 24 June.

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING VERIFICATION

Table 2 provides the number of hours in advance of formation with the first NHC Tropical Weather Outlook (TWO) forecast in each likelihood category. Figure 5 shows composites of 7-day TWO genesis areas for each category prior to the formation of Cindy. It can be seen that NHC accurately forecast the location of Cindy's formation, which was contained within all tropical cyclone genesis areas depicted in the Graphical Tropical Weather Outlook.

A verification of NHC official track forecasts for Cindy is given in Table 3a. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b and illustrated in Fig. 6. NHC's track errors were slightly higher than their 5-yr means. A verification of NHC official intensity forecasts for Cindy is given in Table 4a. A homogeneous comparison of the official track errors with selected guidance models is given in Table 4b and illustrated in Fig. 7.   NHC's intensity errors were well below their 5-yr means.

There were no coastal watches or warnings issued for Cindy.

REFERENCES

Goldenberg, Stanley B. and L.J. Shapiro, 1996. Physical Mechanisms for the Association of El Niño and West African Rainfall with Atlantic Major Hurricane Activity. *Journal of Climate*, Volume 9. Issue 6. 1169-1187.

Table 1.   Best track for Tropical Storm Cindy, 22–26 June 2023.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
22 / 0000	10.4	39.9	1008	30	tropical depression
22 / 0600	10.7	41.1	1008	30	"
22 / 1200	11.0	42.3	1008	30	"
22 / 1800	11.3	43.5	1008	30	"
23 / 0000	11.5	44.8	1007	35	tropical storm
23 / 0600	11.8	46.1	1006	40	"
23 / 1200	12.2	47.5	1005	45	"
23 / 1800	12.8	48.8	1005	45	"
24 / 0000	13.6	50.0	1005	45	"
24 / 0600	14.6	51.2	1004	50	"
24 / 1200	15.7	52.5	1004	50	"
24 / 1800	16.8	53.9	1005	50	"
25 / 0000	18.2	55.2	1006	45	"
25 / 0600	19.4	56.4	1007	45	"
25 / 1200	20.5	57.6	1009	40	"
25 / 1800	21.6	58.8	1010	40	"
26 / 0000	22.5	59.9	1011	35	"
26 / 0600					dissipated
24 / 0600	14.6	51.2	1004	50	maximum wind and minimum pressure

Table 2.   Number of hours in advance of formation of Cindy 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	**168-Hour Outlook**
Low (<40%)	72	72
Medium (40%-60%)	54	60
High (>60%)	36	42

Table 3.   NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Cindy, 22–26 June 2023. 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	24.0	39.7	58.8	79.5	110.9	136.5		
OCD5	39.3	82.7	150.9	208.2	281.8	329.2		
Forecasts	14	12	10	8	6	4		
OFCL (2018-22)	23.8	35.7	47.8	61.4	76.1	90.5		
OCD5 (2018-22)	46.4	99.2	157.4	215.0	254.9	321.2		

Table 3b.   Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Cindy, 22–26 June 2023. 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	60	72	96	120
OFCL	24.0	39.7	58.8	79.5	110.9	136.5		
OCD5	39.3	82.7	150.9	208.2	281.8	329.2		
GFSI	30.1	58.3	74.2	**79.0**	**102.6**	**117.6**		
HMNI	27.9	48.7	75.1	92.3	117.2	148.8		
HWFI	33.4	65.9	96.3	122.3	160.8	216.1		
HFAI	27.7	45.3	70.0	90.1	118.1	142.6		
HFBI	25.4	**38.6**	59.7	87.0	111.5	150.0		
EGRI	**23.7**	**34.4**	**55.9**	84.2	124.8	182.1		
EMXI	**22.6**	**35.0**	**57.5**	**77.8**	**100.5**	**130.0**		
CMCI	25.2	40.8	**55.6**	**68.9**	**84.7**	**105.5**		
CTCI	28.3	47.2	68.4	96.9	136.5	152.1		
AEMI	26.3	47.7	60.0	**63.7**	**77.9**	**95.7**		
TVCA	24.6	40.2	**58.6**	**77.4**	**107.2**	144.0		
HCCA	**22.3**	**37.0**	**50.5**	**64.8**	**92.1**	**127.3**		
Forecasts	14	12	10	8	6	4		

Table 4.   NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Cindy, 22–26 June 2023. 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	**1.8**	**2.5**	**2.0**	**2.5**	**4.2**	**5.0**		
OCD5	4.8	7.2	10.4	11.5	12.0	5.5		
Forecasts	14	12	10	8	6	4		
OFCL (2018-22)	5.1	7.6	8.9	10.1	10.7	11.5		
OCD5 (2018-22)	6.8	10.7	13.9	16.5	18.3	20.2		

Table 4b.   Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Cindy, 22–26 June 2023. 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.

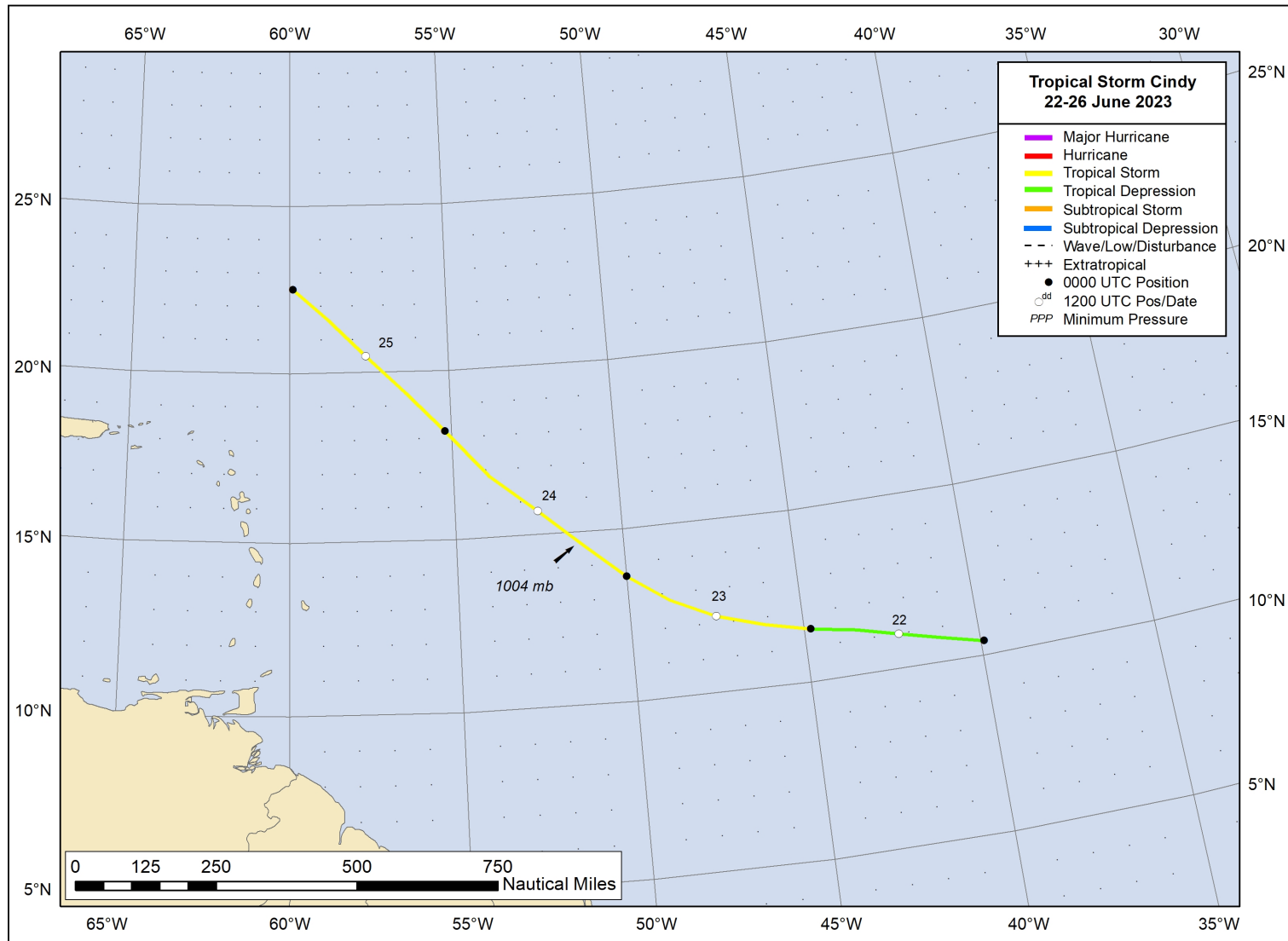| Model ID	Forecast Period (h)							
	12	24	36	48	60	72	96	120
OFCL	1.8	2.5	2.0	2.5	4.2	5.0		
OCD5	4.8	7.2	10.4	11.5	12.0	5.5		
HWFI	3.1	3.8	8.2	12.9	18.8	22.5		
HMNI	4.9	6.5	5.2	8.4	8.2	**3.5**		
HFAI	2.7	4.1	5.0	5.4	5.3	6.8		
HFBI	4.4	7.2	5.8	5.6	4.2	8.2		
CTCI	2.8	3.8	5.0	4.9	4.3	**4.2**		
GFSI	3.5	5.8	6.5	6.8	6.5	**4.5**		
EMXI	3.6	6.6	7.9	8.5	6.5	**4.5**		
IVCN	3.1	4.5	5.6	6.5	8.2	7.0		
HCCA	2.8	4.6	6.3	7.9	9.7	9.8		
Forecasts	14	12	10	8	6	4		

Figure 1.   Best track positions for Tropical Storm Cindy, 22–26 June 2023.
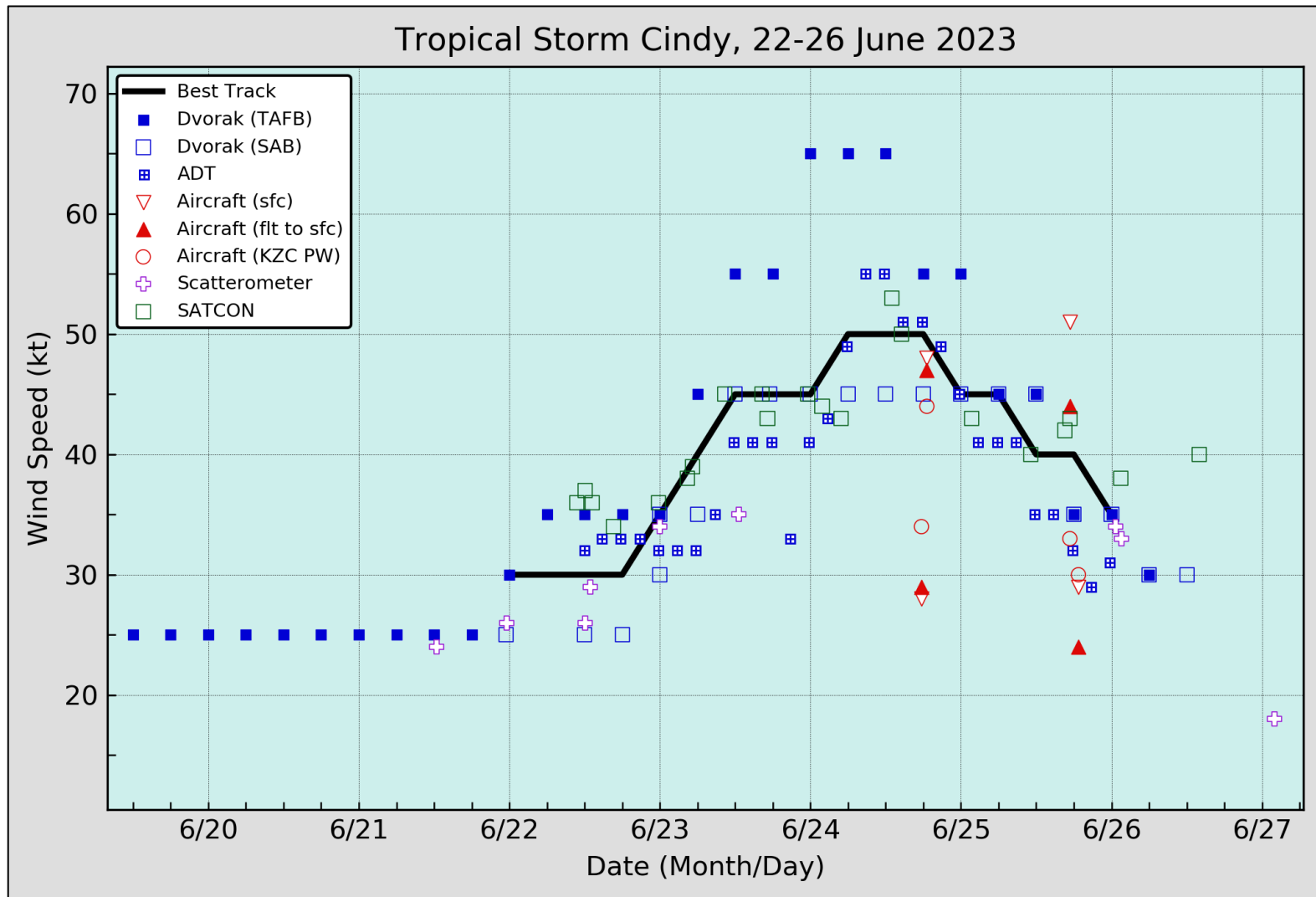
Figure 2.   Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Cindy, 22–26 June 2023. Aircraft observations have been adjusted for elevation using 80% adjustment factor for observations from 850 mb. Advanced Dvorak Technique estimates represent the 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.
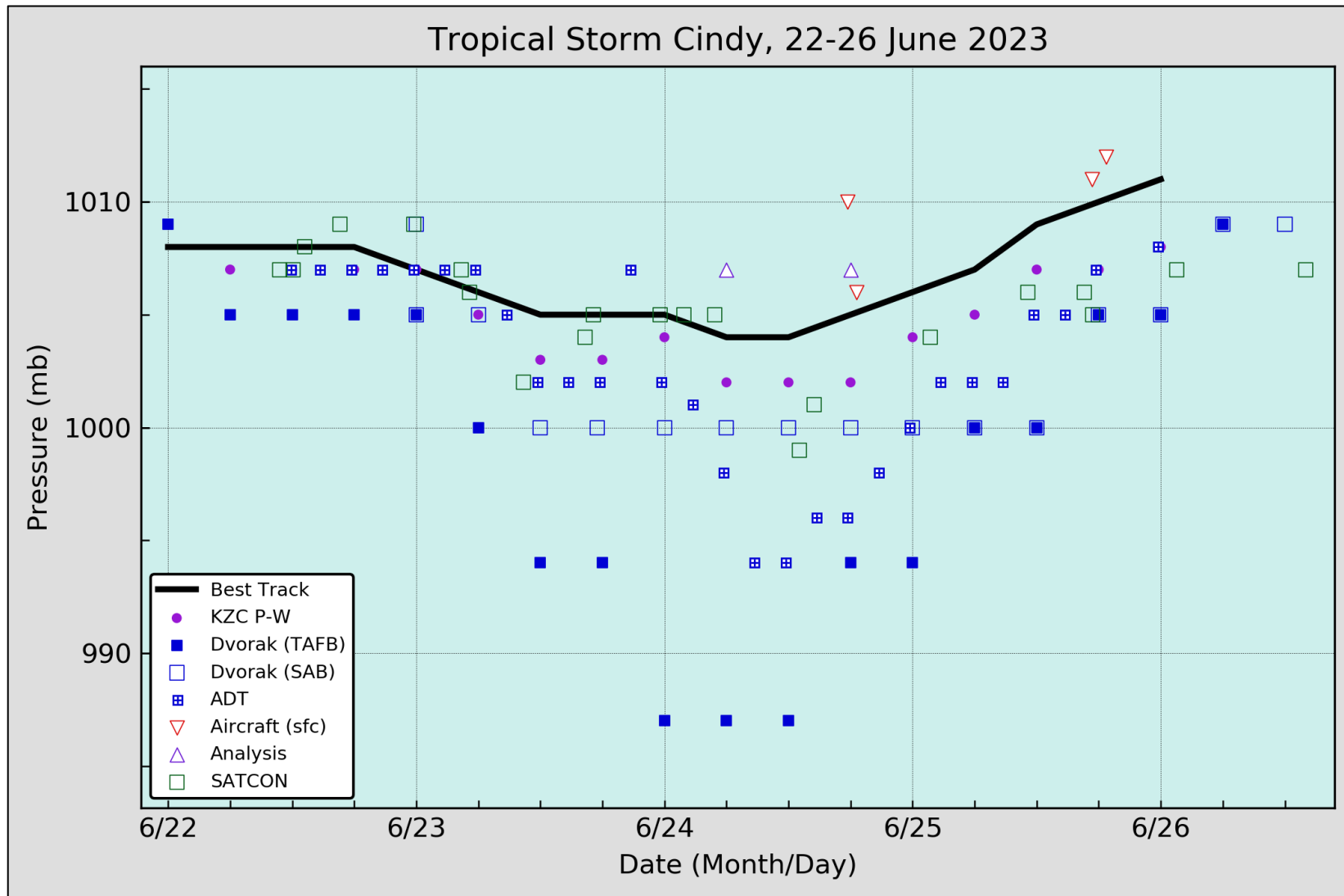
Figure 3.   Selected pressure observations and best track minimum central pressure curve for Tropical Storm Cindy, 22–26 June 2023. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological 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.
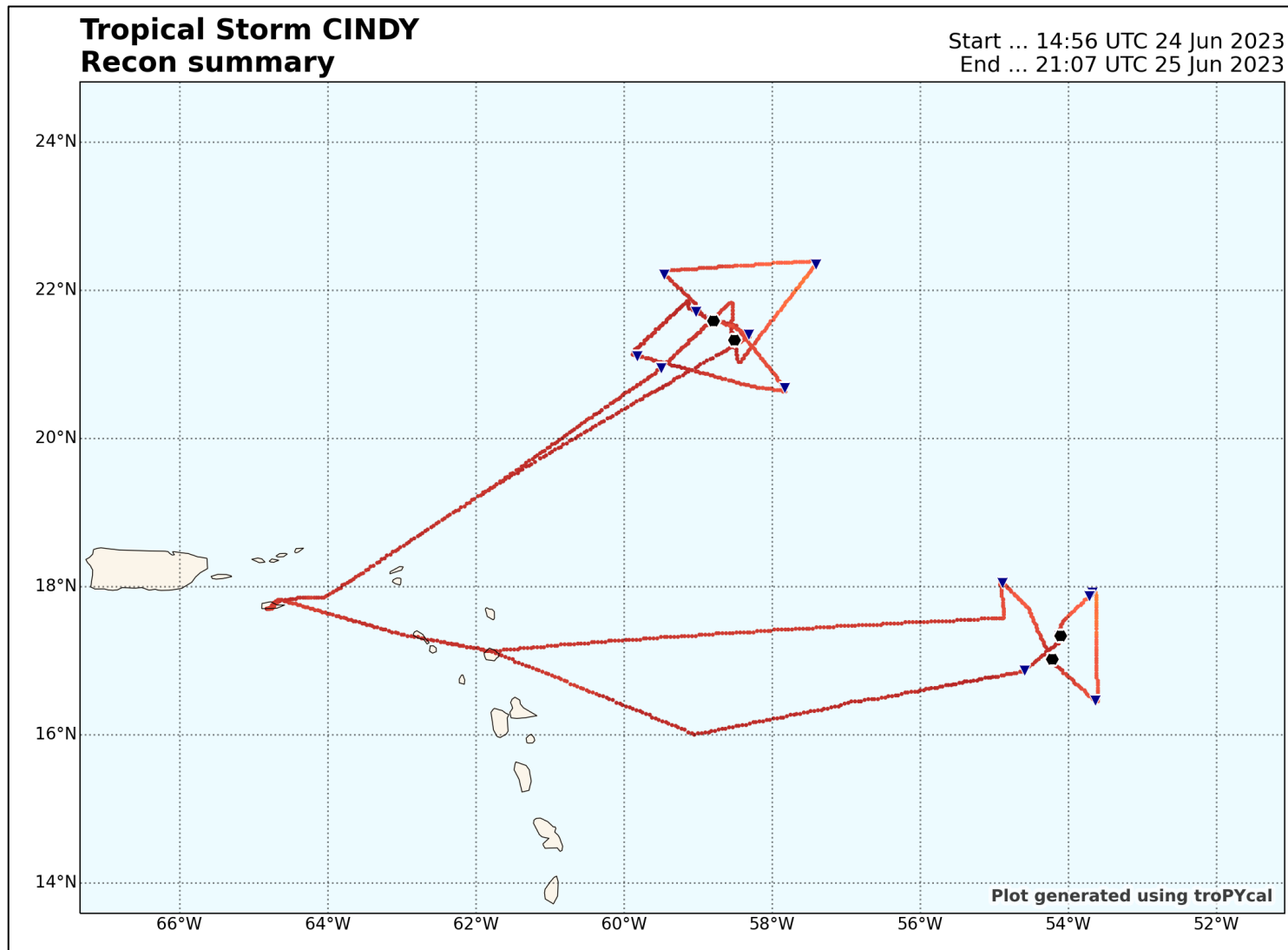
Figure 4.   Air Force Reserve Hurricane Hunter aircraft flight tracks from the two reconnaissance missions into Tropical Storm Cindy.
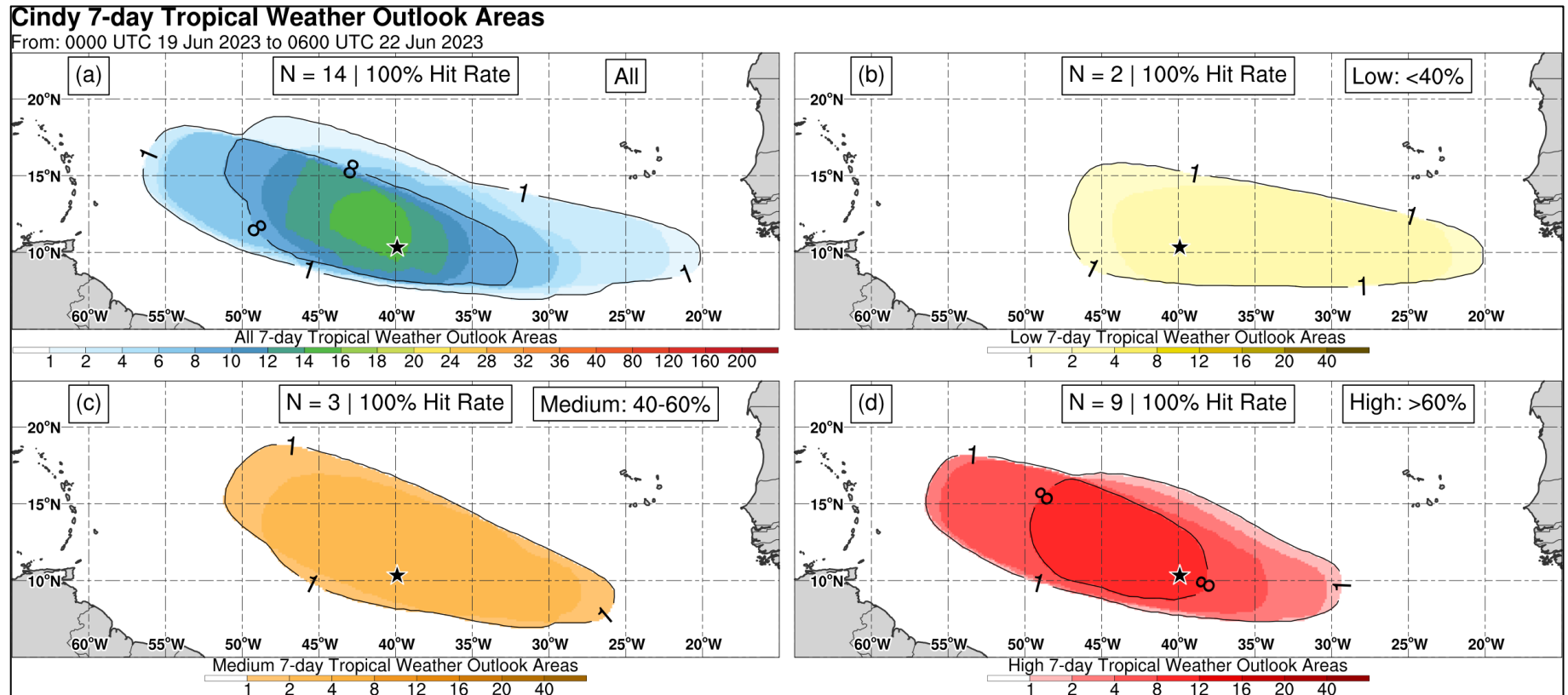
Figure 5.   Composites of 7-day tropical cyclone genesis areas depicted in NHC's Tropical Weather Outlooks prior to the formation of Tropical Storm Cindy for (a) all probabilistic genesis categories, (b) the low (<40%) category, (c) medium (40–60%) category, and (d) high (>60%) category. Cindy's location of genesis is indicated by the black star.
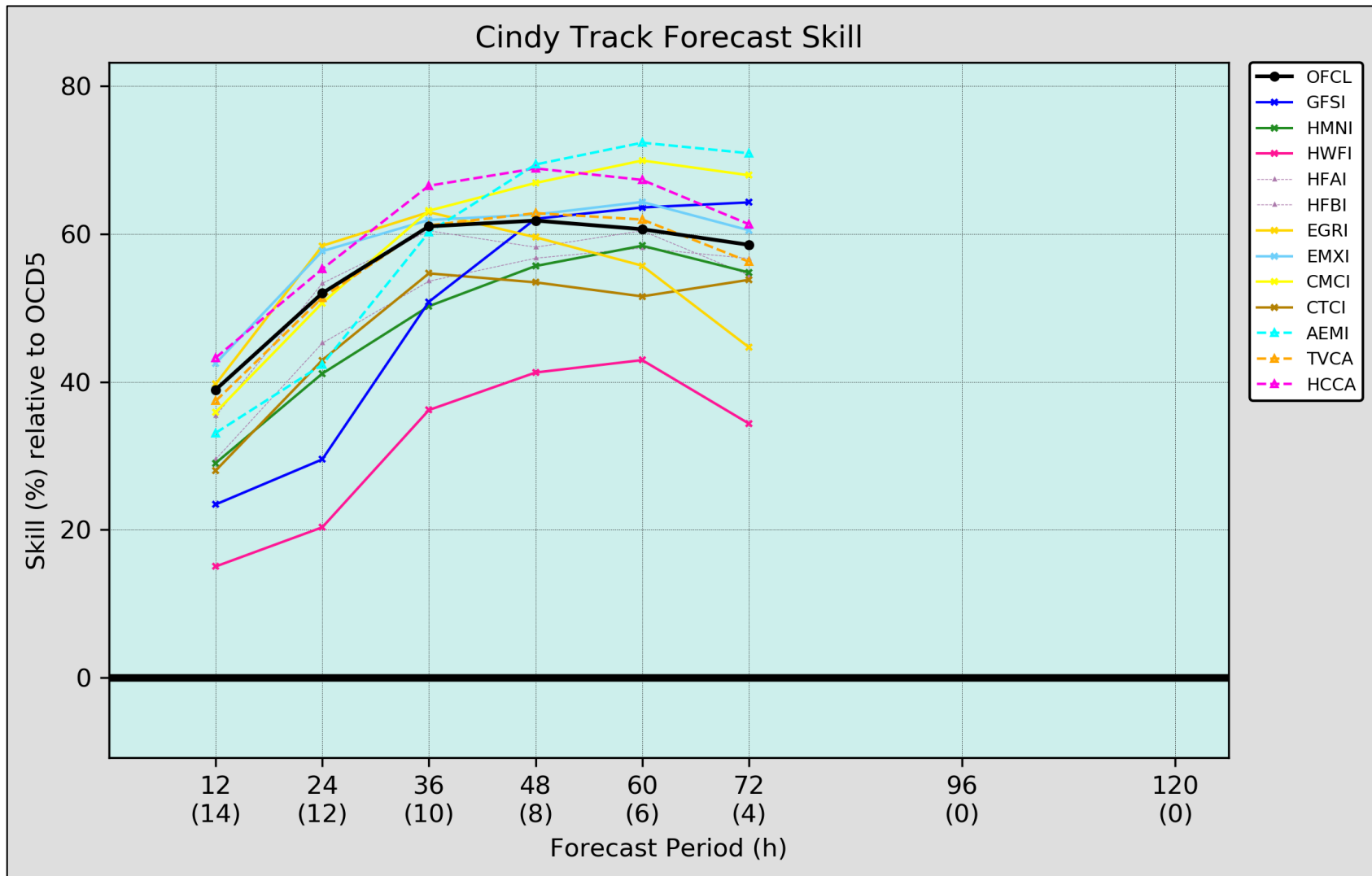
Figure 6.　　Official forecast and selected model forecast track skill for Tropical Storm Cindy, 22–26 June 2023
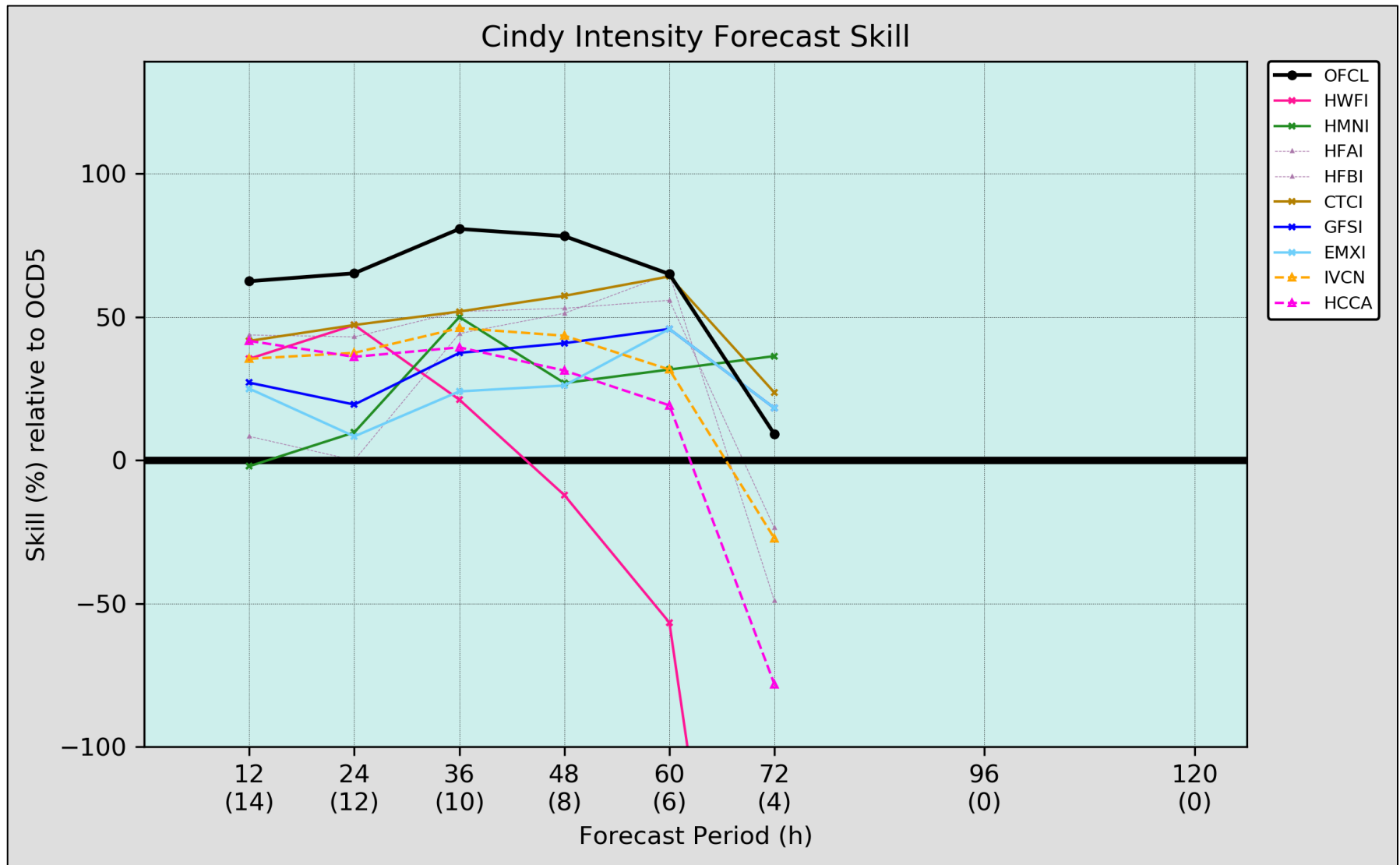
Figure 7.   Official forecast and selected model forecast intensity skill for Tropical Storm Cindy, 22–26 June 2023