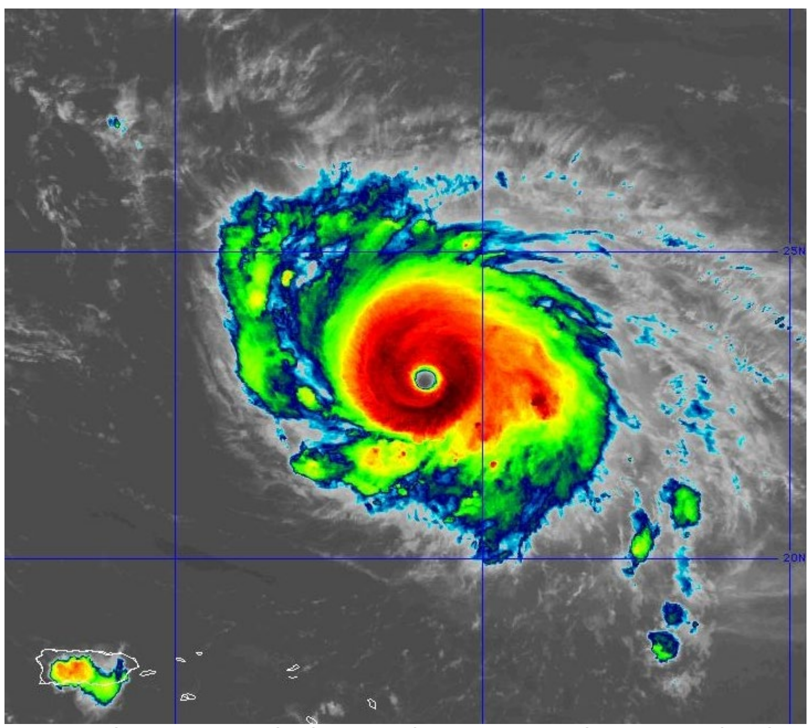
NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE HUMBERTO

(AL082025)

24 September – 1 October 2025

Andrew B. Hagen
National Hurricane Center
11 December 2025



GOES-EAST INFRARED SATELLITE IMAGE OF HURRICANE HUMBERTO AT 2000 UTC 27 SEPTEMBER 2025 AROUND THE TIME OF ITS PEAK INTENSITY. IMAGE COURTESY OF NOAA/NESDIS/STAR.

Humberto formed over the tropical Atlantic and peaked as a category 5 hurricane (on the Saffir-Simpson Hurricane Wind Scale). Although Humberto did not directly impact land, it passed close enough to Bermuda to prompt a Tropical Storm Watch for the island.

Hurricane Humberto

24 SEPTEMBER – 1 OCTOBER 2025

SYNOPTIC HISTORY

Humberto originated from a tropical wave that emerged off the west coast of Africa between 18–19 September. The wave was initially enveloped in dry, stable air until after it crossed 40°W early on 22 September. Convection increased the next day as broad cyclonic turning was noted in the low-levels of the atmosphere. Visible satellite imagery suggested that a well-defined low-level circulation formed along with sufficiently organized deep convection on 24 September, and it is estimated that Tropical Storm Humberto formed by 1200 UTC that day about 525 n mi east-northeast of the northern Leeward Islands. At the time of genesis, tropical-storm-force winds were already occurring in the eastern semicircle, based on scatterometer (ASCAT) data from 12 h earlier. The "best track" chart of Humberto'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].

Initially, Humberto was in an environment of moderate westerly vertical wind shear, but it was able to gradually strengthen on 25 September due to warm sea-surface temperatures (SSTs) and a moist low- to mid-level troposphere. Humberto intensified into a 60-kt tropical storm by 0000 UTC 26 September about 400 n mi northeast of the northern Leeward Islands. The cyclone moved generally west-northwestward during its first few days of existence along the southwestern periphery of the subtropical ridge. However, a mid-latitude upper-level trough to the north temporarily weakened the ridge, which caused Humberto's motion to slow to 5 kt or less from 1200 UTC 25 September until 0600 UTC 27 September. Once the ridge strengthened again, Humberto resumed moving at a more typical speed toward the west-northwest, passing well north of the Leeward Islands late on 27 September. The aforementioned westerly wind shear lessened on 26 September, allowing an inner core to become established. Humberto began a 42-h period of rapid intensification from a 60-kt tropical storm to a 140-kt category 5 hurricane from 0000 UTC 26 September to 1800 UTC 27 September. Humberto was located about 300 n mi north-northeast of the northern Leeward Islands near the time it reached category 5 strength.

On 28 September, Humberto underwent an eyewall replacement cycle (ERC) as it turned northwestward over the southwestern Atlantic Ocean. The ERC was a very gradual process, taking about 36 h to complete, and the hurricane displayed a double-eyewall structure for an unusually long period of time. At the time of peak intensity late on 27 September, convective bands were already starting to organize into an outer ring-like formation (Fig. 4a). By early afternoon the next day, the outer convective ring was closed, strengthening, and contracting, but

---

[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.

the inner ring was still prominent (Fig. 4b). Several hours later, Synthetic Aperture Radar (SAR) data from RADARSAT-2 at 2222 UTC 28 September (not shown) and wind data collected around 0000 UTC 29 September by the Air Force Reserve Hurricane Hunters both indicated a double wind maxima structure, with winds in the outer eyewall stronger than the winds in the inner eyewall in all quadrants. A Weather System Follow-on Microwave (WSF-M) pass from this period also showed a weakening inner eyewall (Fig. 4c), consistent with the other data indicating the outer eyewall was becoming dominant.

As a result of the ERC, Humberto weakened from 140 kt at 0000 UTC 28 September to 120 kt 24 h later. After the ERC completed, Air Force Hurricane Hunter aircraft data indicated that Humberto re-strengthened slightly to a 125-kt hurricane by 1200 UTC 29 September while located about 315 n mi south-southwest of Bermuda. Thereafter, increasing wind shear and gradually decreasing SSTs led to rapid weakening as Humberto turned northward, well to the west of Bermuda, in between the subtropical ridge to its east and Hurricane Imelda to its west-southwest. Hurricanes Humberto and Imelda made their closest approach to each other around 1800 UTC 30 September, with Imelda centered about 405 n mi southwest of Humberto. Figure 5 shows the two hurricanes over the western Atlantic about 11 h later when they were 460 n mi apart. On 1 October, Humberto accelerated east-northeastward towards a digging mid-latitude trough and transitioned to an extratropical cyclone with 65-kt winds at 1200 UTC as it merged with a front, about 230 n mi north of Bermuda. Humberto's surface circulation then became extremely elongated and dissipated within the frontal boundary later that day. It is interesting to note that Hurricane Imelda merged with the same powerful mid-latitude trough and associated cold front the next day.

METEOROLOGICAL STATISTICS

Observations in Humberto (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), objective Advanced Dvorak Technique (ADT) estimates and Satellite Consensus (SATCON) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison. Observations also include flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from four flights of the 53rd Weather Reconnaissance Squadron of the U.S. Air Force Reserve Command (Fig. 6). 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), the Defense Meteorological Satellite Program (DMSP) satellites, and the Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats (TROPICS) satellites, among others, were also useful in constructing the best track of Humberto. Surface observations from Oshen C-Star Uncrewed Surface Vessels (USVs) were also helpful in constructing the best track of Humberto.

Ship and buoy reports of winds of tropical storm force associated with Humberto are given in Table 2. Humberto did not produce any sustained tropical-storm-force winds on land, but two weather stations on Bermuda recorded wind gusts up to 36 kt from Humberto on 30 September and 1 October.

When Hurricanes Humberto and Imelda made their closest approach to each other, it was the 2nd closest together two hurricanes have been in the Atlantic basin HURDAT database since 1851, and the closest since the beginning of the satellite era in the mid-1960s when records are considered more complete (Michael Lowry, personal communication).

Winds and Pressure

The peak intensity of 140 kt from 1800 UTC 27 September through 0000 UTC 28 September is based on a subjective Dvorak Current Intensity estimate of 140 kt from TAFB, as well as the UW-CIMSS ADT, SATCON, and DPRINT objective intensity methods, all of which peaked at 140 kt.

The first reconnaissance flight into Humberto occurred around 0000 UTC 29 September, about 24 h after the estimated peak intensity. During those 24 h, satellite imagery and microwave images show that Humberto was likely weakening as it went through an ERC. A dropsonde from that flight measured a pressure of 929 mb with 10-kt winds in the eye, implying a central pressure of 928 mb, which is 14 mb below what the KZC pressure-wind relationship[2] gives for the 120-kt intensity at the time. Given that the KZC was running high, Humberto's lifetime minimum pressure (during the time of the 140-kt peak intensity 24 h earlier) is estimated to be around 918 mb, which is a bit lower than the suggested KZC pressure value. It should be noted that there is greater than normal uncertainty in Humberto's lifetime minimum pressure value since there were no in-situ measurements during the time of peak intensity.

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

The system that became Humberto was introduced into the Tropical Weather Outlook (TWO) with good lead time, but confidence in genesis did not increase until much closer to the time of formation (Table 3). The wave from which Humberto developed was introduced in the Tropical Weather Outlook (TWO) nearly seven days prior to formation. However, the formation probabilities in the 7-day TWO were raised to the medium category (40%-60%) only 3 days before genesis, and to the high category (>60%) 2 days prior to the formation of Humberto. The 48-h

[2] KZC pressure-wind relationships incorporate intensity, storm size, latitude, forward speed, and the value of the outermost closed isobar.

probabilities were introduced 60 h prior to formation, but were raised to the high category only 12 h prior to genesis. The location of Humberto's genesis was not included in the forecast ellipses that were issued 120–162 h prior to genesis, as the western edge of those ellipses did not extend far enough west. However, starting 114 h prior to genesis, every genesis area correctly captured the location of genesis (Fig. 7).

A verification of NHC official track forecasts for Humberto is given in Table 4a. Official track forecast errors were lower than the mean official errors for the previous 5-yr period at all verifying times. The OFCL forecasts were especially impressive on days 3–5 (outperforming the NHC 5-year means by 25–55%), considering that the forecasts were more difficult than average at those time ranges (due to the larger than average OCD5 errors). A homogeneous comparison of the official track errors with selected guidance models is given in Table 4b. The Google DeepMind Ensemble Mean (GDMI) was the best performing track model from 12–48 h, and the GFS model (GFSI) was generally the best performing model from 60–120 h. Both of the aforementioned models outperformed the NHC forecast for the track of Humberto. It should be noted that the GDMI model was sometimes not available early enough to be utilized by NHC forecasters. The European model (EMXI) performed quite poorly compared with the other dynamical track models.

A verification of NHC official intensity forecasts for Humberto is given in Table 5a. Official intensity forecast errors were significantly greater than the mean official errors for the previous 5-yr period at all lead times. The OCD5 errors were much larger than climatology through 96 h, which indicates that predicting Humberto's intensity was much more difficult than average. NHC (and all of the models) under-forecasted Humberto's intensity for the first several forecasts (Figs. 8a-8d). NHC correctly forecast that Humberto would undergo a period of rapid intensification on 3 of its first 6 forecasts. However, those first 6 forecasts did not show Humberto becoming stronger than a category 3. After peak intensity, NHC's intensity forecasts were too high, and Humberto weakened faster than expected. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 5b and illustrated in Figure 8. The Florida State Superensemble (FSSE) was the best-performing intensity model from 12–72 h (Fig. 8b), and it outperformed NHC's official forecast by a significant margin at 36–72 h. The HCCA (Fig. 8c), GDMI (Fig. 8d), HAFS and HWRF models were also strong performers, relative to the rest of the guidance.

Watches and warnings associated with Humberto are given in Table 6. A Tropical Storm Watch was issued for Bermuda late on 28 September. The watch for Humberto was discontinued and replaced with a Hurricane Watch for Hurricane Imelda late on 29 September, which was forecast to more directly impact the island.

ACKNOWLEDGEMENTS

Dr. Lisa Bucci of NHC assisted in the creation of Figure 8. Dr. Philippe Papin of NHC created Figures 1 and 7.

Table 1. Best track for Hurricane Humberto, 24 September–1 October 2025.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
24 / 1200	19.1	53.6	1008	35	tropical storm
24 / 1800	19.8	54.5	1008	35	"
25 / 0000	20.4	55.4	1007	40	"
25 / 0600	20.9	56.2	1006	45	"
25 / 1200	21.3	56.5	1002	50	"
25 / 1800	21.5	56.7	998	55	"
26 / 0000	21.7	56.9	993	60	"
26 / 0600	21.9	57.0	984	70	hurricane
26 / 1200	22.1	57.4	978	80	"
26 / 1800	22.2	57.8	966	95	"
27 / 0000	22.1	58.4	949	115	"
27 / 0600	22.2	58.9	938	125	"
27 / 1200	22.5	59.7	932	130	"
27 / 1800	22.7	60.7	919	140	"
28 / 0000	23.1	61.6	918	140	"
28 / 0600	23.7	62.7	921	135	"
28 / 1200	24.2	63.8	926	125	"
28 / 1800	25.1	64.8	926	125	"
29 / 0000	25.8	65.8	928	120	"
29 / 0600	26.7	66.6	933	120	"
29 / 1200	27.5	67.3	938	125	"
29 / 1800	28.5	67.9	948	115	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
30 / 0000	29.5	68.6	961	100	"
30 / 0600	31.0	69.4	967	90	"
30 / 1200	32.5	69.8	977	70	"
30 / 1800	33.5	69.9	979	70	"
01 / 0000	34.6	69.0	979	70	"
01 / 0600	35.7	67.5	979	70	"
01 / 1200	36.1	65.5	981	65	extratropical
01 / 1800					dissipated
28 / 0000	23.1	61.6	918	140	minimum pressure and maximum winds

Table 2. Selected ship and buoy reports with winds of at least 34 kt for Hurricane Humberto, 24 September–1 October 2025.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/ speed (kt)	Pressure (mb)
30 / 1500	C6EO4	33.0	72.1	030 / 35	1012.0
30 / 1700	C6EO4	33.3	71.9	020 / 40	1013.0
01 / 0652	VDCY	40.6	69.2	040 / 36	
NOAA Buoys					
27 / 0207	41044	21.6	58.6	253 / 42	999.3

Table 3. 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	168-Hour Outlook
Low (<40%)	60	162
Medium (40%-60%)	24	72
High (>60%)	12	48

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Humberto, 24 September–1 October 2025. 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	**18.0**	**27.8**	**35.2**	**42.6**	**53.6**	**66.5**	**76.9**	**83.9**
OCD5	41.6	83.9	135.9	195.1	267.5	333.0	464.3	548.7
Forecasts	25	23	21	19	17	15	11	7
OFCL (2020-24)	23.0	34.3	45.8	58.7	73.5	89.8	128.7	185.4
OCD5 (2020-24)	45.1	95.7	150.9	203.1	252.7	295.4	366.2	426.6

Table 4b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Humberto, 24 September–1 October 2025. 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	16.2	25.9	35.8	42.9	56.6	75.9	100.4	120.0
OCD5	38.0	76.9	124.6	187.5	267.2	340.2	498.6	593.5
GFSI	20.0	**23.0**	**28.3**	**31.7**	**38.9**	**43.6**	**75.1**	**67.8**
HWFI	19.0	29.7	47.0	61.9	82.1	105.0	165.7	162.3
HMNI	18.9	29.6	44.5	53.6	64.0	80.4	**95.3**	130.1
HFAI	19.6	25.9	37.1	55.6	73.3	91.4	105.7	155.9
HFBI	19.7	**21.3**	**33.1**	46.8	63.8	77.4	**83.6**	136.3
GDMI	**15.3**	**20.7**	**26.9**	**30.8**	**43.0**	**54.4**	**77.6**	**103.6**
EMXI	19.8	35.9	51.8	77.1	106.3	141.6	207.6	231.7
NVGI	28.5	32.4	54.9	76.2	108.4	146.9	247.5	236.1
CMCI	20.9	27.6	**35.1**	47.0	57.6	**61.2**	**89.1**	**111.2**
CTCI	17.8	32.4	55.3	67.6	74.8	91.2	135.5	**87.7**
TVCA	17.1	**22.3**	**35.2**	46.0	63.5	83.8	111.1	**101.6**
TVCX	16.5	**23.0**	36.1	47.5	65.6	87.7	114.6	**107.6**
GFEX	16.5	**23.6**	**34.2**	48.9	69.8	92.2	137.7	145.1
TVDG	16.5	**21.9**	**33.8**	43.3	61.8	83.3	113.7	**106.8**
HCCA	17.0	**22.5**	**35.3**	49.7	67.5	91.0	120.7	**119.7**
FSSE	17.1	**22.3**	**35.5**	55.6	77.3	96.1	130.9	**90.4**
AEMI	20.0	**24.5**	**27.9**	**35.1**	**52.6**	**71.4**	116.3	131.0
TABS	44.7	82.2	131.2	188.2	246.0	321.4	487.3	613.3
TABM	28.2	40.4	45.2	53.6	57.2	**64.2**	**54.0**	**81.0**
TABD	22.9	39.5	75.5	105.8	138.0	174.1	259.2	360.0
Forecasts	20	18	17	15	13	11	7	3

Table 5a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Humberto, 24 September–1 October 2025. 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	8.6	15.7	22.6	26.3	28.2	26.3	21.8	15.0
OCD5	12.6	22.4	31.3	39.6	44.8	44.6	36.5	18.9
Forecasts	25	23	21	19	17	15	11	7
OFCL (2020-24)	5.1	7.3	8.6	10.0	10.5	10.9	12.4	13.6
OCD5 (2020-24)	6.8	10.6	13.8	16.5	17.9	19.2	21.4	19.9

Table 5b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Humberto, 24 September–1 October 2025. 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 5a due to the homogeneity requirement.

Model ID	Forecast Period (h)							
	12	24	36	48	60	72	96	120
OFCL	8.6	16.6	21.7	21.2	20.7	18.8	20.6	20.0
OCD5	12.9	24.1	32.2	37.2	39.3	36.9	27.5	**6.0**
HWFI	12.0	19.0	**21.6**	**21.0**	**17.5**	**15.7**	22.5	36.0
HMNI	12.1	19.2	23.6	24.0	22.1	**18.4**	**20.2**	25.2
HFAI	10.8	16.6	**19.3**	**20.1**	**18.6**	**12.6**	**19.6**	**11.0**
HFBI	11.2	**16.5**	**21.4**	21.2	**17.3**	**11.1**	20.6	**11.2**
GDMI	11.1	**16.4**	**19.8**	**19.2**	**16.5**	**16.2**	**12.1**	**9.2**
DSHP	11.7	18.0	**21.5**	25.3	26.2	27.3	27.1	**6.8**
LGEM	11.7	19.1	25.3	27.2	27.1	26.2	27.4	**11.0**
ICON	11.2	18.1	22.3	23.6	21.5	20.8	21.9	**18.5**
IVCN	11.0	17.2	**21.4**	22.4	**19.3**	**16.5**	**19.2**	**10.2**
IVDR	10.8	17.4	**21.6**	21.9	**18.7**	**15.5**	**17.9**	**10.8**
CTCI	10.2	18.4	22.1	23.2	**16.6**	**11.2**	**8.2**	**9.0**
GFSI	11.8	19.7	23.2	25.1	25.6	23.3	**16.2**	**8.2**
EMXI	14.1	24.9	34.8	37.8	34.4	29.8	26.9	33.5
HCCA	10.7	**14.7**	**18.3**	**20.8**	**19.4**	**16.7**	**20.4**	20.5
FSSE	10.6	**14.1**	**17.1**	**17.4**	**14.9**	**9.8**	**18.1**	23.2
Forecasts	21	19	18	16	14	12	8	4

Table 6. Watch and warning summary for Hurricane Humberto, 24 September–1 October 2025.

Date/Time (UTC)	Action	Location
28 / 2100	Tropical Storm Watch issued	Bermuda
29 / 2100	Tropical Storm Watch discontinued for Humberto and replaced with Hurricane Watch for Imelda	Bermuda

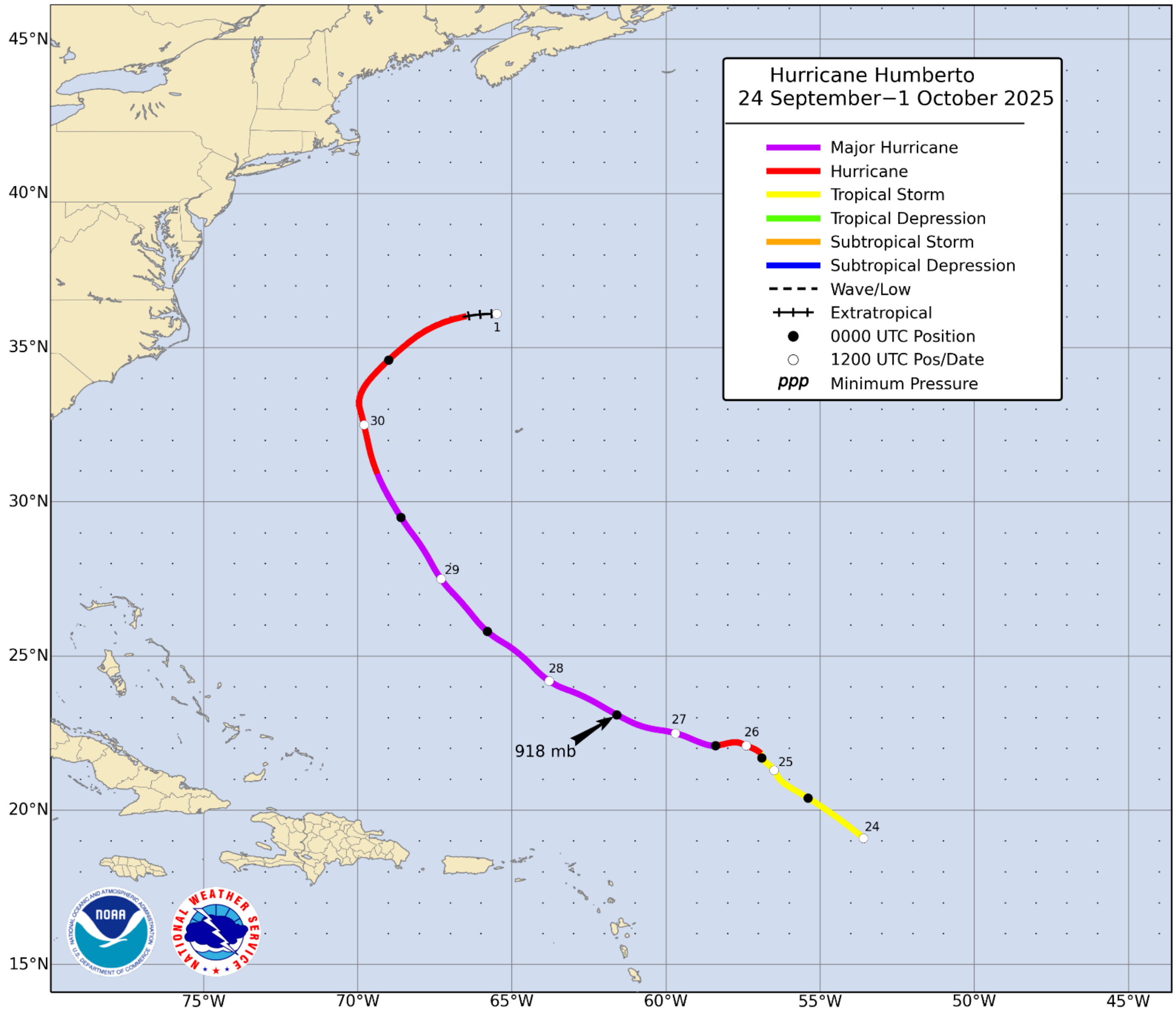


Figure 1. Best track positions for Hurricane Humberto, 24 September–1 October 2025.

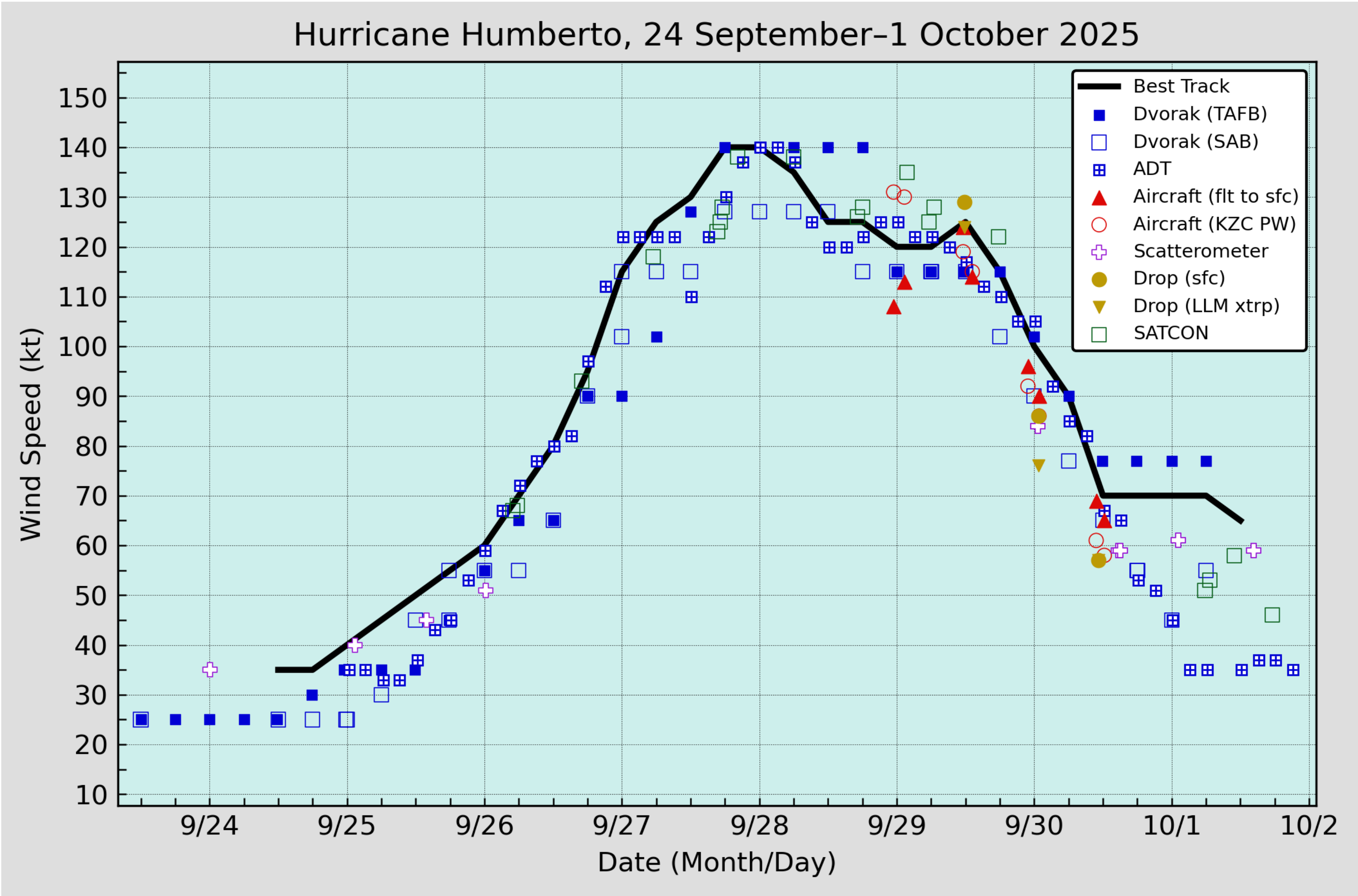


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Humberto, 24 September–1 October 2025. Aircraft observations have been adjusted for elevation using 90%, 80%, and 75% adjustment factors for observations from 700 mb, 850 mb, and 925 mb, respectively. Dropwindsonde observations include actual 10 m winds (sfc), as well as surface estimates derived from the mean wind over the lowest 150 m of the wind sounding (LLM). 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.

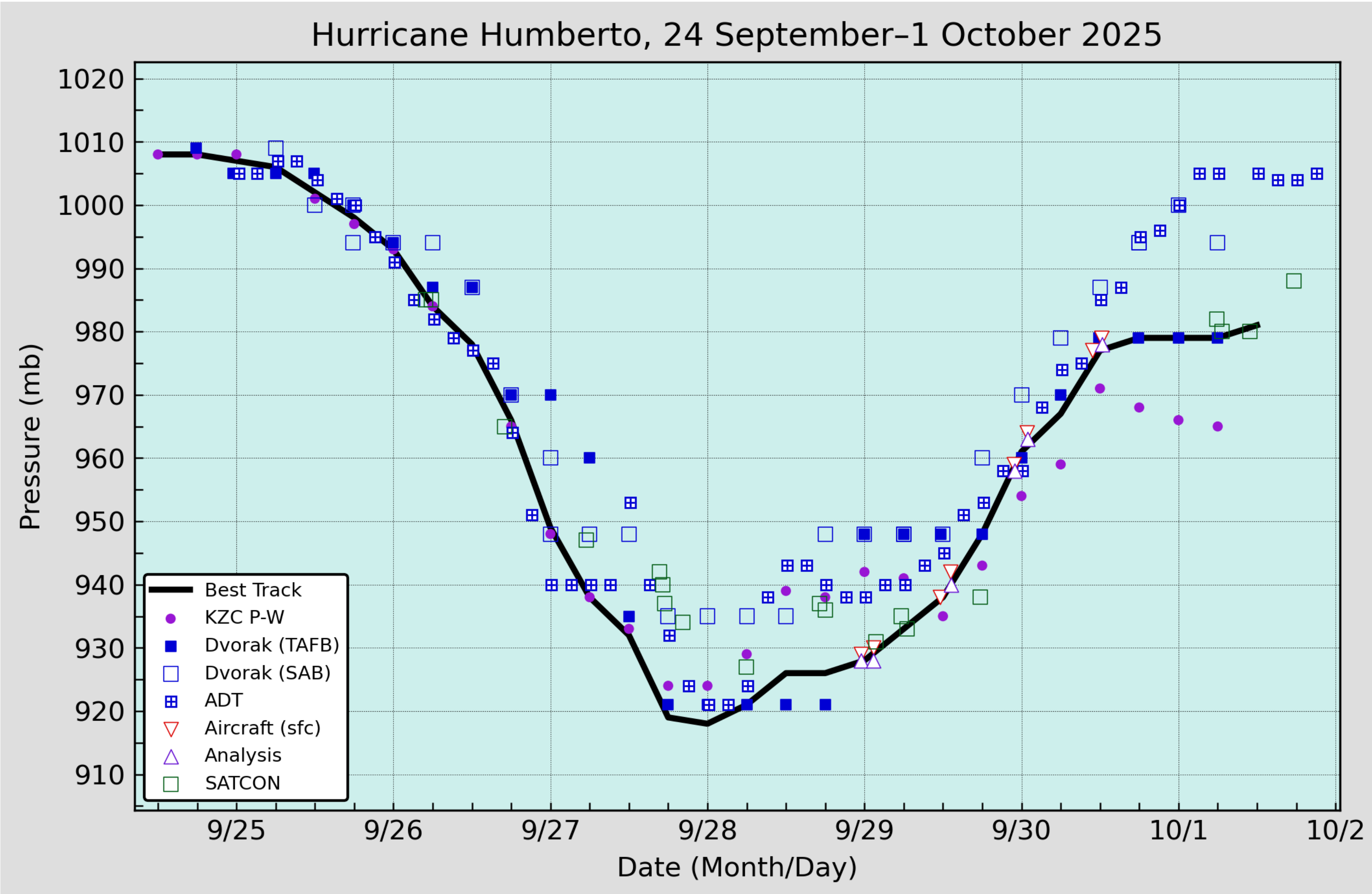


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Humberto, 24 September–1 October 2025. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute 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.

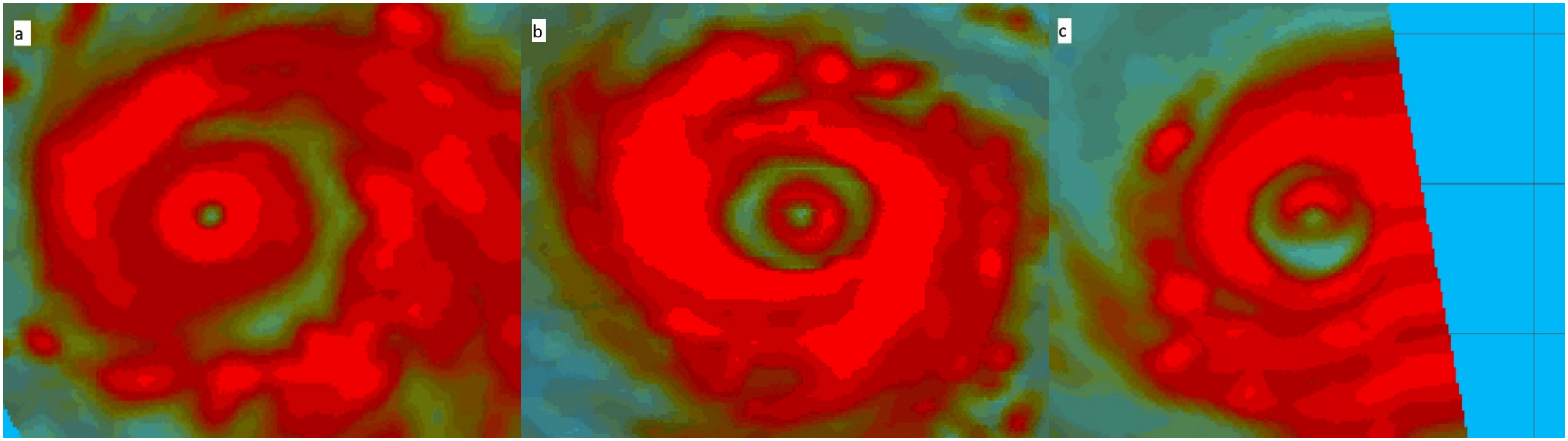
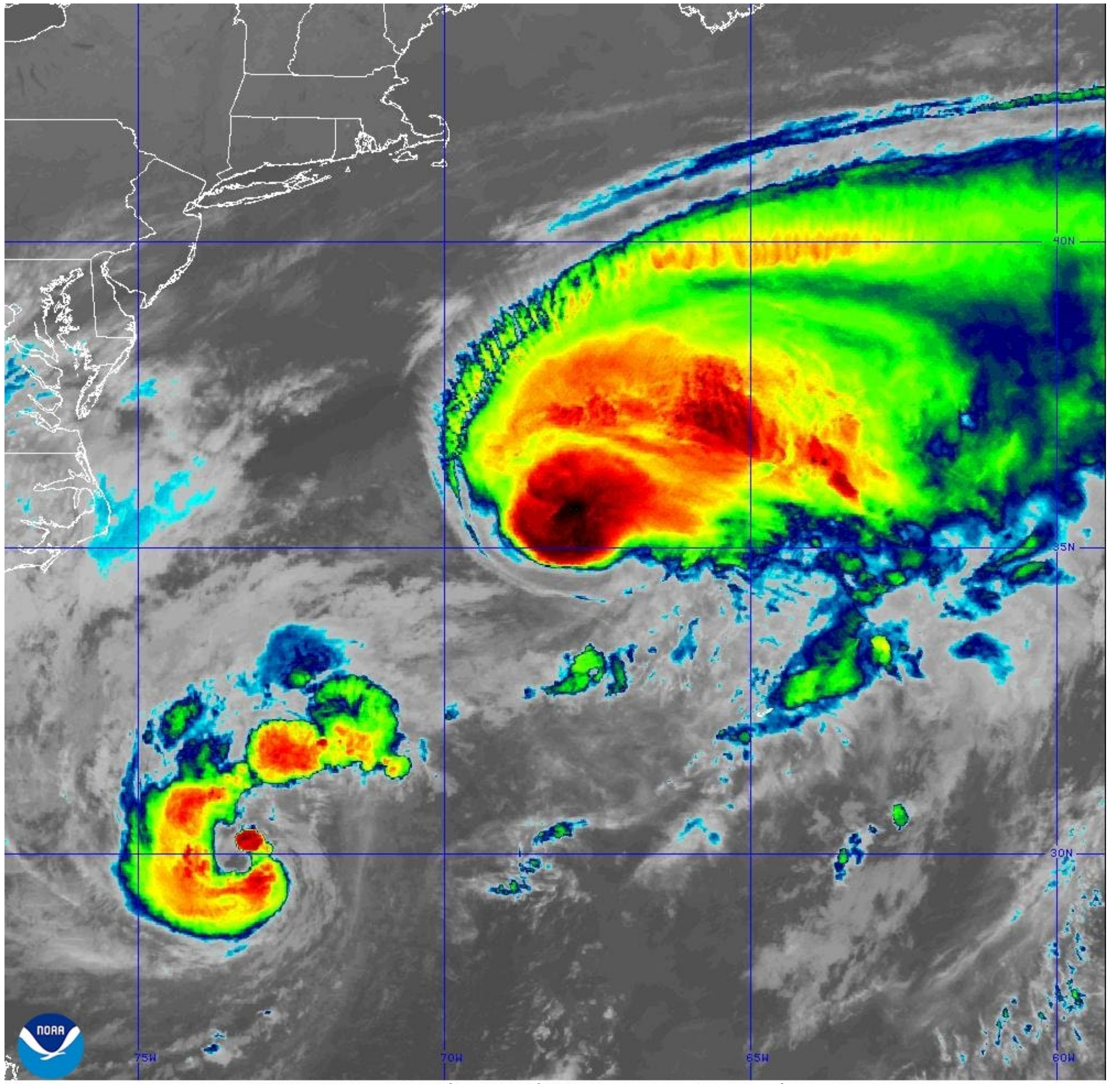


Figure 4. A comparison of the 89-GHz microwave images in chronological order to illustrate Humberto's eyewall replacement cycle: a) GPMI image at 27 September at 2142 UTC, b) AMSR2 image at 28/1738 UTC, and c) WSF-M image at 28/2235 UTC.



01 Oct 2025 04:50Z - NOAA/NESDIS/STAR - GOES-19 - Band 13 - AL082025

Figure 5. GOES-E infrared satellite image showing both Hurricane Humberto (center) and Hurricane Imelda (lower left) at 0450 UTC 1 October. Humberto was centered about 460 n mi to the northeast of Imelda at the time.

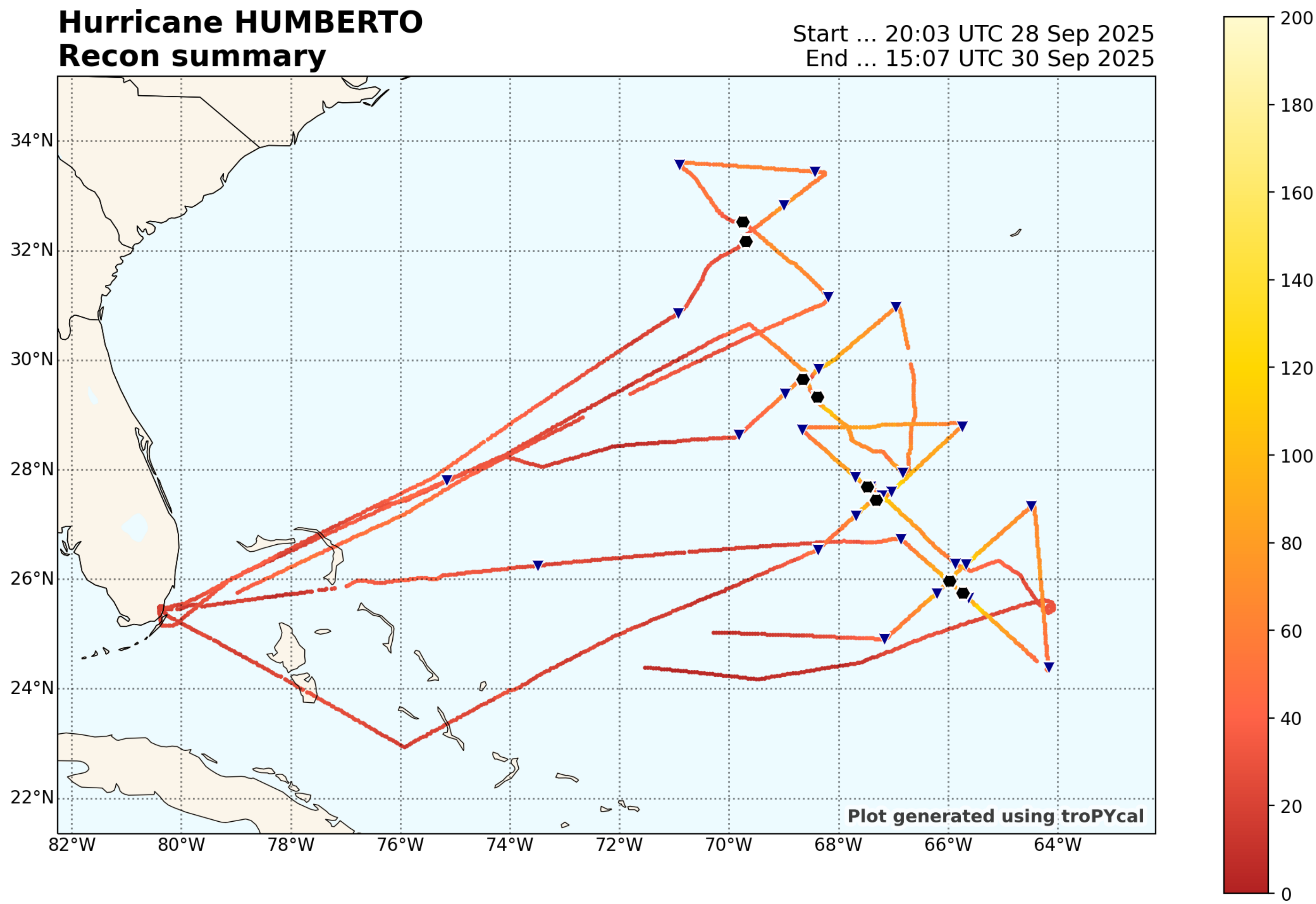


Figure 6. Air Force Reserve Hurricane Hunter aircraft flight tracks (colored lines) from reconnaissance missions into Humberto from 28–30 September 2025. The black markers denote center fixes, and the blue triangles indicate dropsonde locations. The color coding of the flight tracks represents the observed flight-level wind speed in knots at that location (see legend).

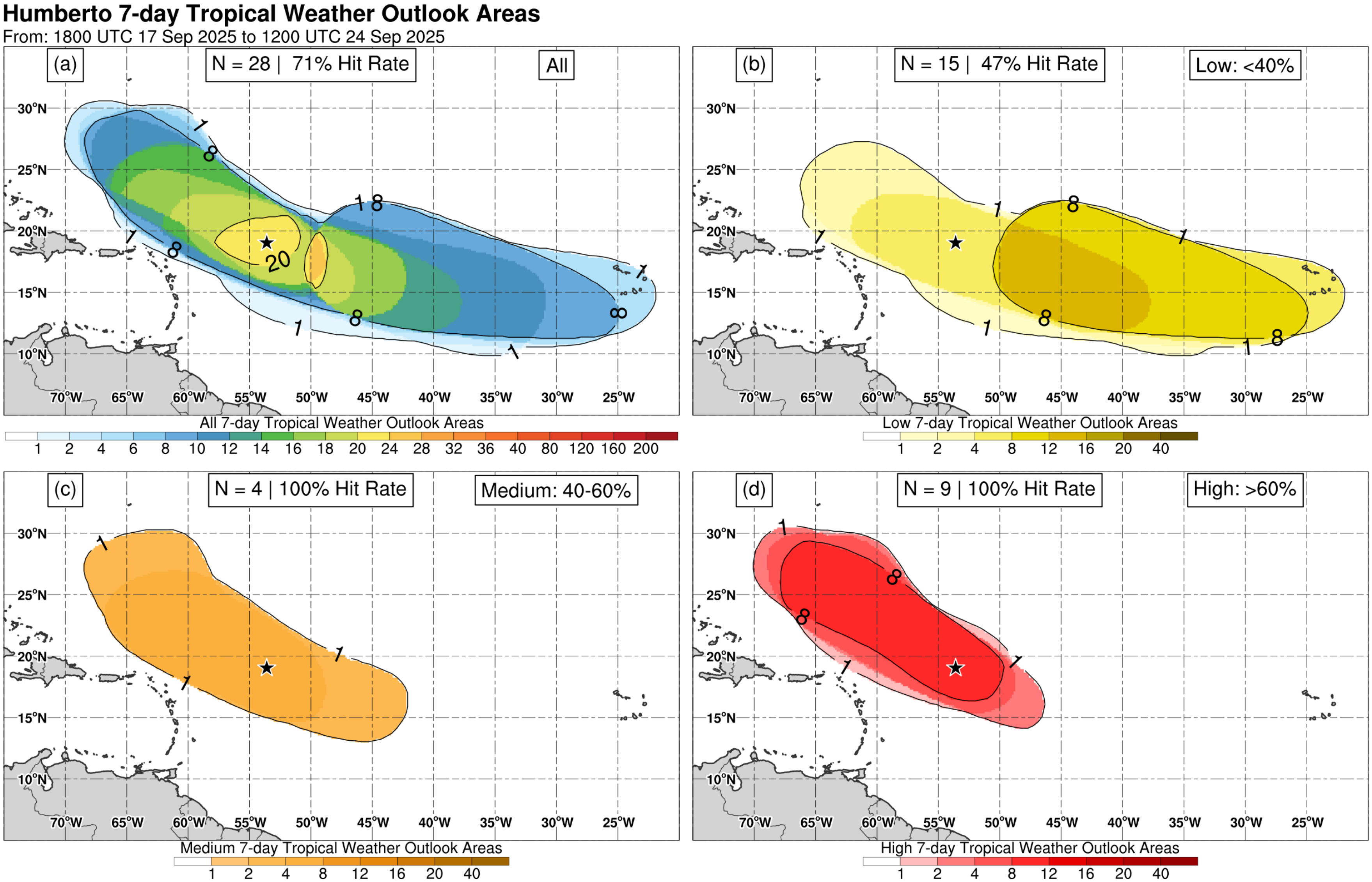


Figure 7. Composites of 7-day tropical cyclone genesis areas depicted in NHC's Tropical Weather Outlooks prior to the formation of Hurricane Humberto for (a) all probabilistic genesis categories, (b) the low (<40%) category, (c) medium (40–60%) category, and (d) high (>60%) category. The location of genesis is indicated by the black star.

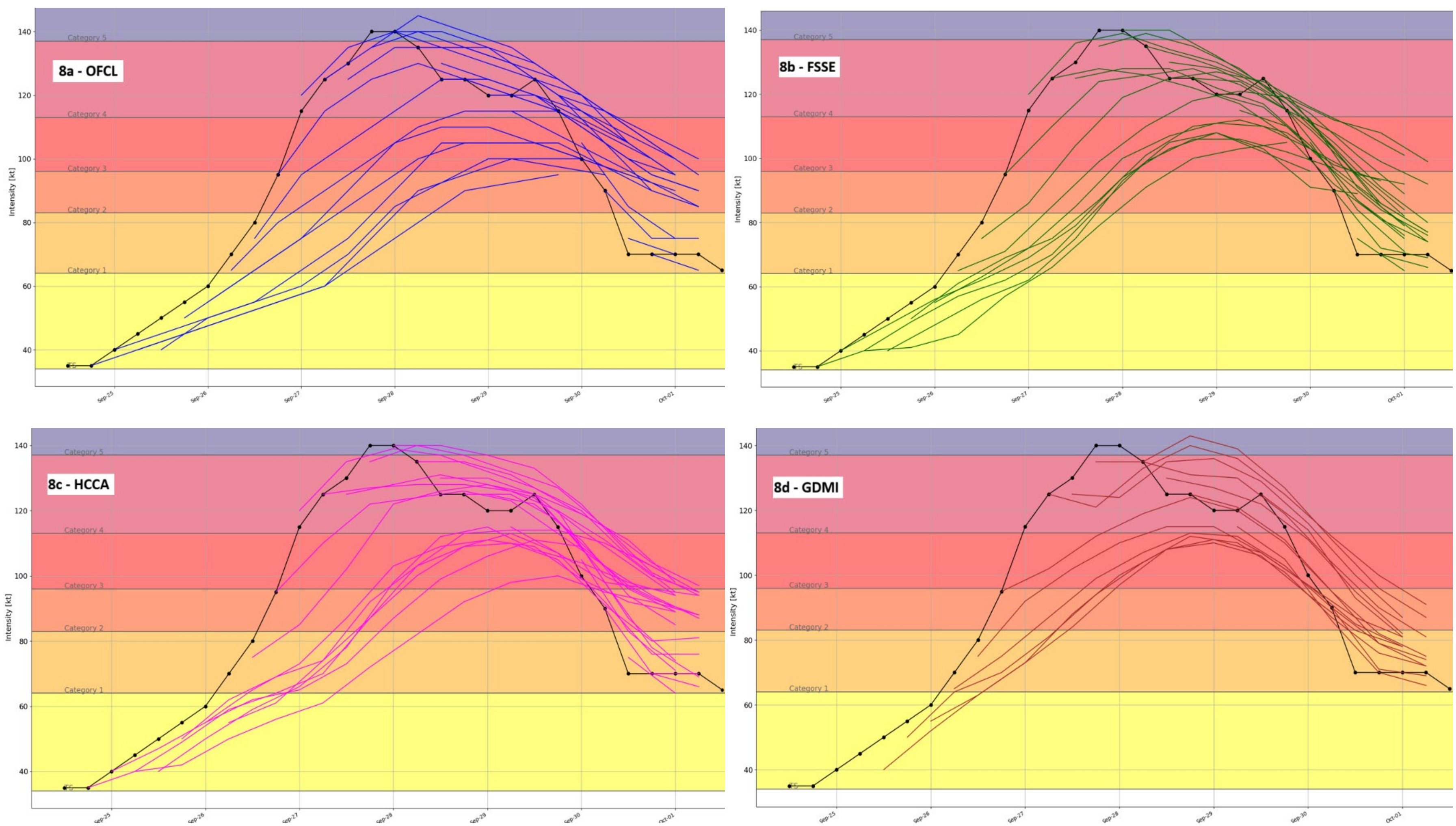


Figure 8. Intensity forecasts for Hurricane Humberto. The colored lines are the forecasts, with the black line the verifying values. Top left (8a) is the NHC forecast (OFCL), top right (8b) FSSE, bottom left (8c) HCCA and bottom right (8d) GDMI.