NATIONAL HURRICANE CENTER
TROPICAL CYCLONE REPORT

TROPICAL STORM GASTON

(AL082022)

20–25 September 2022

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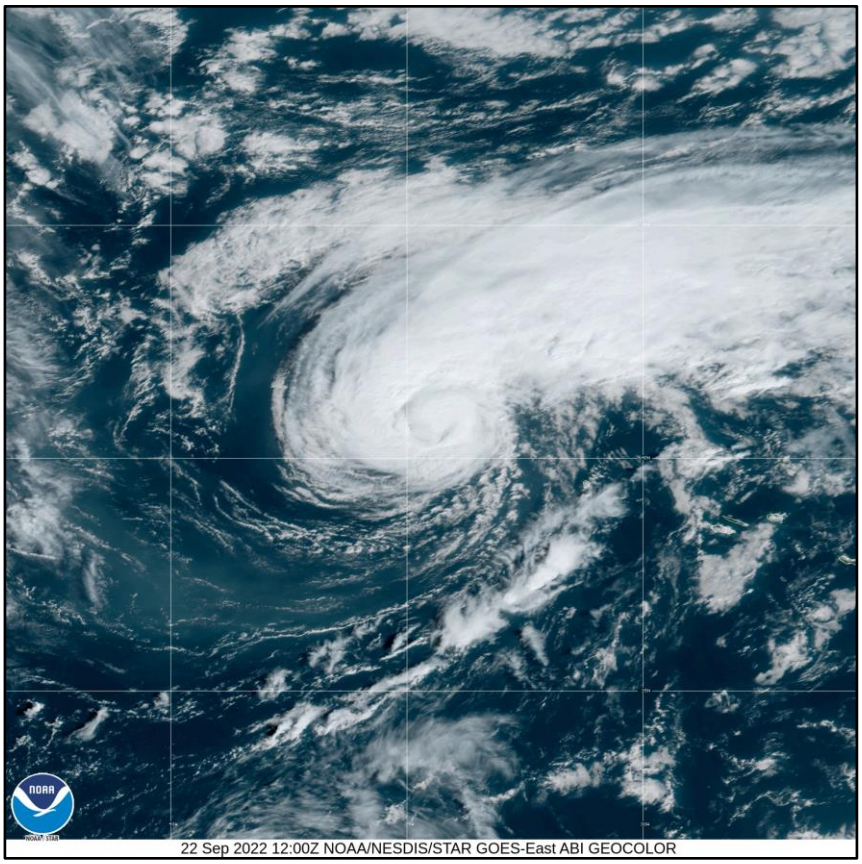

GOES-16 GEOCOLOR IMAGE OF TROPICAL STORM GASTON AT 1200 UTC 22 SEPTEMBER 2023, NEAR ITS PEAK INTENSITY OF 55 KT. IMAGE COURTESY OF NOAA/NESDIS/STAR.

Gaston was a tropical storm at subtropical to middle latitudes that caused tropical-storm-force winds over portions of the Azores.

Tropical Storm Gaston

20–25 SEPTEMBER 2022

SYNOPTIC HISTORY

Although Gaston formed at a relatively high latitude, it was triggered by a tropical wave, in fact the next wave to come out of Africa after the one that spawned powerful Hurricane Fiona. This next wave moved off the west coast of Africa on 12 September, and produced some disorganized showers and thunderstorms while it moved between the African coast and the Cabo Verde Islands. The wave moved across those islands on 13 September accompanied by widely scattered deep convection. Over the next few days, the system moved westward over the tropical Atlantic while producing some disorganized showers and thunderstorms. Deep convection gradually became more consolidated over the northern portion of the wave on 16-17 September, and on 18 September an area of disturbed weather about 1000 n mi east-northeast of the northern Leeward Islands moved northward out of the wave. On 19 September, a surface low formed within the disturbance about 1000 n mi east-southeast of Bermuda. This low moved northward over the central Atlantic accompanied by sporadic and disorganized deep convection for about a day. By 1200 UTC 20 September the system, which had already developed a well-defined surface circulation, acquired enough organized deep convection to designate the formation of a tropical depression centered about 960 n mi east of Bermuda. 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, the tropical cyclone was situated on the western side of a high pressure area over the eastern Atlantic, and it strengthened into a tropical storm by 1800 UTC 20 September. Gaston moved northward and north-northeastward around the northwestern side of the high, with some increase in forward speed. Although the storm was in an environment of moderate to strong southwesterly shear and over marginal sea surface temperatures, the cyclone was able to strengthen to its peak intensity of about 55 kt early on 21 September when it was centered about 580 n mi west-southwest of Flores Island in the Azores. Gaston then turned toward the northeast and east-northeast through 22 September while slowing in forward speed and maintaining its intensity as it moved along the northern side of the high. Turning toward the east, the center of the cyclone passed about 100 n mi north of Flores at 0000 UTC 23 September. A blocking mid-level high built to the north of Gaston and became the dominant steering mechanism, which caused the storm to turn toward the southeast and south on the 23rd. The system also weakened somewhat that day, likely due to the intrusion of drier air, and its convective

[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.

cloud pattern lost organization. Under the influence of the blocking high to its north, Gaston turned toward the southwest, and passed about 40 n mi northwest of Faial in the Azores at 0000 UTC 24 September with maximum winds near 45 kt. Moving along the southern side of the high, the cyclone turned toward the west with little change in strength, passing about 85 n mi south of Flores around 1800 UTC 24 September. Gaston then turned toward the west-northwest while gradually weakening, and its associated deep convection diminished to result in the system becoming a 35-kt post-tropical cyclone by 0000 UTC 26 September. The cyclone soon weakened into a remnant low that turned west-southwestward and dissipated over the subtropical central Atlantic around 0000 UTC 28 September.

METEOROLOGICAL STATISTICS

Observations in Gaston (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. 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. The analyzed peak intensity and minimum pressure of Gaston, 55 kt and 994 mb respectively, are based on subjective Dvorak satellite estimates.

On 23 September, Flores Airport in the Azores reported a sustained wind of 27 kt with a gust to 42 kt at 1530 UTC, and a minimum pressure of 1015 mb at 1500 UTC. Horta on Faial Island in the Azores reported a sustained wind of 28 kt with a gust to 38 kt at 0830 UTC 24 September, and a minimum pressure of 1010 mb at 1900 UTC 23 September. It is likely that sustained tropical-storm-force winds occurred over some parts of the Azores, although these were not reported.

Ship reports of winds of tropical storm force associated with Gaston are given in Table 2.

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

The genesis of this storm was not well predicted. The tropical wave that led to the formation of Gaston was introduced into the Tropical Weather Outlook (TWO) with a low (<40%)

chance of development within 5 days at 1200 UTC 9 September, which was 11 days prior to genesis while the wave was still well inland over Africa (Table 3). The system was removed from the TWO at 0000 UTC 14 September. It was re-introduced into the TWO at 0000 UTC 16 September, 108 h before formation, with a low 5-day chance of development. The system was first assigned a low 2-day chance of development 42 h before formation. The 2- and 5-day genesis probabilities only reached the medium (40%-60%) category a mere 12 h before genesis, and were never raised to high prior to Gaston's formation. Although the forecasts of genesis in the deep tropics did not verify, the graphical TWOs did a much better job of capturing the correct area of formation when the feature was re-introduced at higher latitudes (Fig. 4).

A verification of NHC official track forecasts for Gaston is given in Table 4a. Official track forecast errors were similar to the mean official errors for the previous 5-yr period through 36 h, and greater than the long-term means at 48 through 120 h. the first few NHC forecasts called for Gaston to turn northwestward, but it instead made an anticyclonic turn and then moved westward. This likely contributed to the larger-than-average track errors at the long range. A homogeneous comparison of the official track errors with selected guidance models is given in Table 4b. Many of the models had lower track errors than the official forecasts, and the corrected-consensus model HCCA was generally the best performer.

A verification of NHC official intensity forecasts for Gaston is given in Table 5a. Official intensity forecast errors were quite a bit lower than the mean official errors for the previous 5-yr period at all forecast intervals. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 5b. None of the models had intensity errors that were much below the official forecasts through 48 h, and all of the guidance models had larger intensity errors than the official forecasts at 60 through 120 h. None of the official forecasts issued for Gaston called for the system to become a hurricane, which turned out to be correct.

Coastal watches and warnings associated with Gaston are given in Table 6.

Table 1. Best track for Tropical Storm Gaston, 20–25 September 2022.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
19 / 1200	28.7	46.3	1014	25	low
19 / 1800	29.6	45.8	1014	25	"
20 / 0000	30.4	45.8	1014	25	"
20 / 0600	31.3	45.9	1013	25	"
20 / 1200	32.5	45.8	1013	30	tropical depression
20 / 1800	34.0	45.0	1009	35	tropical storm
21 / 0000	35.5	44.1	1004	45	"
21 / 0600	36.9	43.1	999	55	"
21 / 1200	37.9	42.0	998	55	"
21 / 1800	38.6	40.7	998	55	"
22 / 0000	39.4	38.6	998	55	"
22 / 0600	40.1	36.5	998	55	"
22 / 1200	40.7	34.8	996	55	"
22 / 1800	41.0	33.1	994	55	"
23 / 0000	41.1	31.5	995	55	"
23 / 0600	40.9	30.1	995	55	"
23 / 1200	40.5	29.2	995	55	"
23 / 1800	39.8	28.8	997	50	"
24 / 0000	39.1	29.2	999	45	"
24 / 0600	38.7	29.7	1000	45	"
24 / 1200	38.2	30.4	1001	40	"
24 / 1800	38.0	31.4	998	45	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
25 / 0000	38.4	32.7	998	45	"
25 / 0600	38.9	34.1	999	45	"
25 / 1200	39.4	35.7	999	45	"
25 / 1800	39.2	37.0	1000	40	"
26 / 0000	38.8	37.7	1007	35	post-tropical
26 / 0600	38.5	38.5	1010	35	"
26 / 1200	38.4	39.4	1011	30	low
26 / 1800	38.2	40.4	1012	30	"
27 / 0000	38.0	41.5	1012	30	"
27 / 0600	37.6	42.8	1013	30	"
27 / 1200	37.2	44.2	1014	25	"
27 / 1800	37.0	45.9	1015	25	"
28 / 0000					dissipated
22 / 1800	41.0	33.1	994	55	maximum wind and minimum pressure

Table 2. Selected ship reports with winds of at least 34 kt for Tropical Storm Gaston, 20–25 September 2022.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
22 / 0100	V7QJ5	38.1	38.5	280 / 42	1016.0
24 / 1100	C6PT7	37.5	27.0	140 / 35	1012.6
24 / 1400	C6PT7	37.4	28.2	150 / 36	1015.3

Table 3. Number of hours in advance of formation associated with the first NHC Tropical Weather Outlook (TWO) forecast in the indicated likelihood category. The value in parentheses indicate the number of hours in advance of formation when the disturbance was re-introduced into the TWO. 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%)	42	264 (108)
Medium (40%-60%)	12	12
High (>60%)		

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Gaston, 20–25 September 2022. 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	**21.9**	**33.0**	**46.4**	67.5	89.1	124.6	174.8	243.0
OCD5	76.6	189.4	323.8	482.4	607.1	660.1	678.1	576.0
Forecasts	20	18	16	14	12	10	6	2
OFCL (2017-21)	23.6	35.5	47.6	61.4	78.2	91.3	125.6	172.1
OCD5 (2017-21)	45.5	98.3	156.7	213.7	252.4	316.9	403.6	484.6

Table 4b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Gaston, 20–25 September 2022. 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	21.9	33.0	46.4	67.5	89.1	124.6	174.8	243.0
OCD5	76.6	189.4	323.8	482.4	607.1	660.1	678.1	576.0
GFSI	**21.1**	**29.6**	**43.5**	**58.7**	**76.5**	**113.0**	217.6	470.2
EMXI	**21.4**	**25.7**	**38.1**	**53.2**	**75.4**	**102.7**	**122.0**	**71.1**
NVGI	35.5	55.5	77.6	120.6	158.0	208.6	208.0	**97.3**
HWFI	22.3	35.4	57.7	84.7	111.1	130.5	**164.2**	248.8
HMNI	28.1	39.1	49.8	**56.8**	**66.8**	**84.5**	**139.4**	**160.1**
AEMI	24.2	35.3	55.5	75.9	101.7	141.3	226.4	279.6
HCCA	**20.2**	**20.9**	**30.9**	**43.6**	**56.6**	**82.9**	**129.0**	**223.6**
GFEX	**21.3**	**23.8**	**35.6**	**46.9**	**60.1**	**81.7**	**124.9**	243.4
TVCA	**20.4**	**25.5**	**40.6**	**56.7**	**73.7**	**93.3**	**140.1**	250.7
TVCX	**20.4**	**25.5**	**38.4**	**53.0**	**70.4**	**89.6**	**132.3**	**221.5**
TVDG	**21.2**	**24.9**	**36.6**	**51.4**	**67.1**	**89.7**	**138.5**	262.4
TABD	60.2	122.9	180.5	251.2	357.3	537.9	1227.8	1561.7
TABM	44.1	68.3	77.4	82.7	91.4	**112.1**	223.3	416.5
TABS	47.3	103.3	157.2	207.1	235.8	243.4	259.2	334.7
Forecasts	20	18	16	14	12	10	6	2

Table 5a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Gaston, 20–25 September 2022. 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	**3.8**	**5.3**	**4.7**	**4.6**	**3.8**	**2.5**	**2.5**	**2.5**
OCD5	5.1	6.6	6.1	7.7	11.6	16.8	21.0	16.0
Forecasts	20	18	16	14	12	10	6	2
OFCL (2017-21)	5.4	8.0	9.5	10.9	11.0	12.1	13.1	14.7
OCD5 (2017-21)	7.0	11.1	14.5	17.1	18.0	20.2	21.9	22.1

Table 5b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Gaston, 20–25 September 2022. 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	3.8	5.3	4.7	4.6	3.8	2.5	2.5	2.5
OCD5	5.1	6.6	6.1	7.7	11.6	16.8	21.0	16.0
HWFI	4.7	5.7	4.8	7.0	7.2	4.0	6.2	4.5
HMNI	4.3	5.6	**4.4**	**3.9**	4.8	4.1	7.5	7.5
DSHP	4.1	**4.3**	5.2	5.8	4.8	5.7	9.3	7.5
LGEM	4.7	5.3	**4.6**	**4.5**	4.6	4.5	5.5	4.5
IVCN	**3.3**	**3.7**	**3.4**	**4.3**	4.6	2.7	6.3	5.5
IVDR	**3.2**	**3.7**	**3.4**	**4.2**	4.3	2.7	5.3	5.0
HCCA	**3.1**	**3.1**	**2.9**	**4.0**	4.8	2.9	6.3	8.0
GFSI	4.2	5.7	5.9	6.4	8.5	6.6	4.7	3.5
EMXI	4.1	6.1	7.8	9.6	9.7	9.2	10.8	13.0
Forecasts	20	18	16	14	12	10	6	2

Table 6. Watch and warning summary for Tropical Storm Gaston, 20–25 September 2022.

Date/Time (UTC)	Action	Location
22 / 0900	Tropical Storm Warning issued	Central Azores to Western Azores
24 / 1805	Tropical Storm Warning discontinued	Central Azores
25 / 1200	Tropical Storm Warning discontinued	All

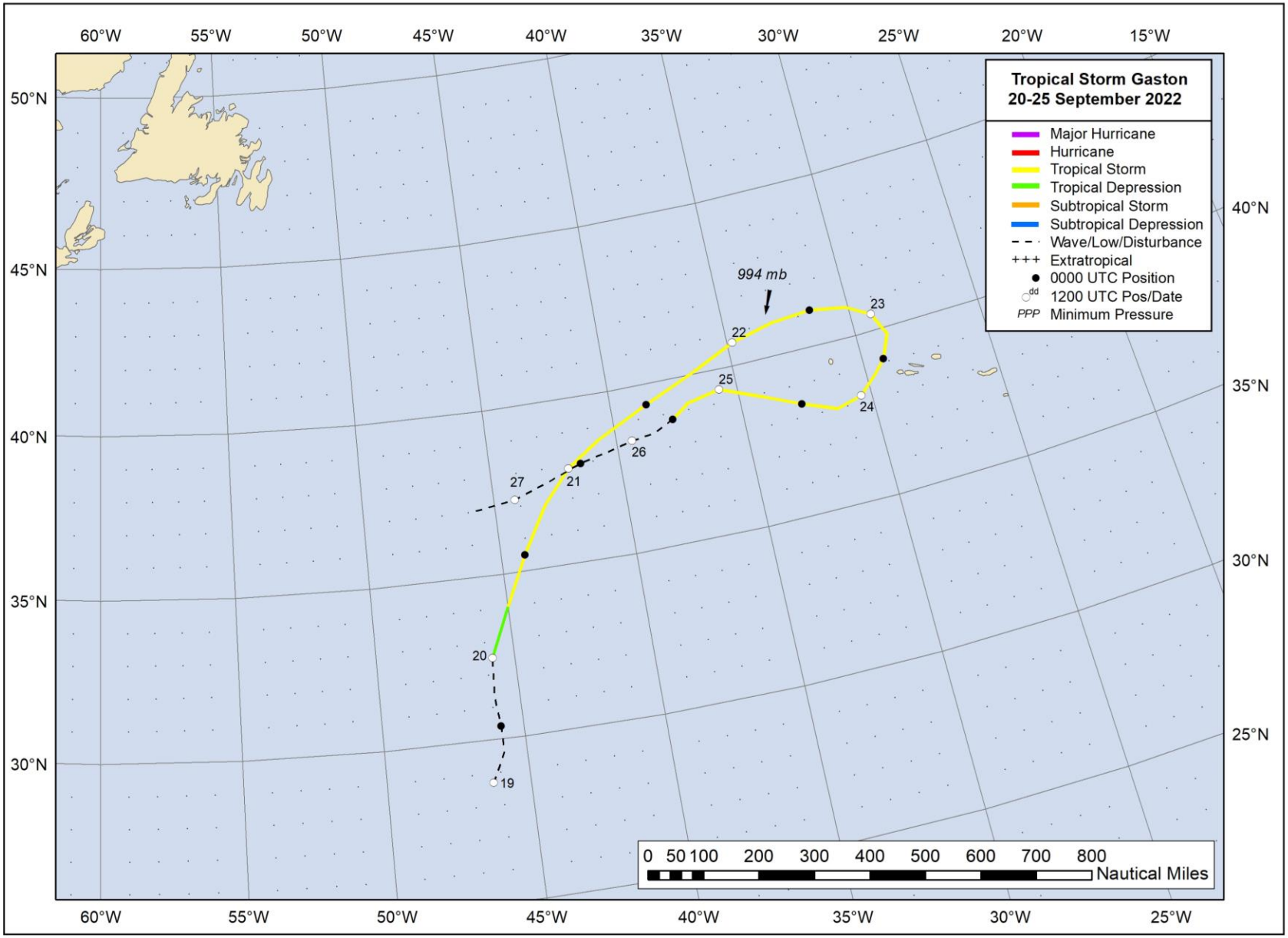

Figure 1. Best track positions for Tropical Storm Gaston, 20–25 September 2022.

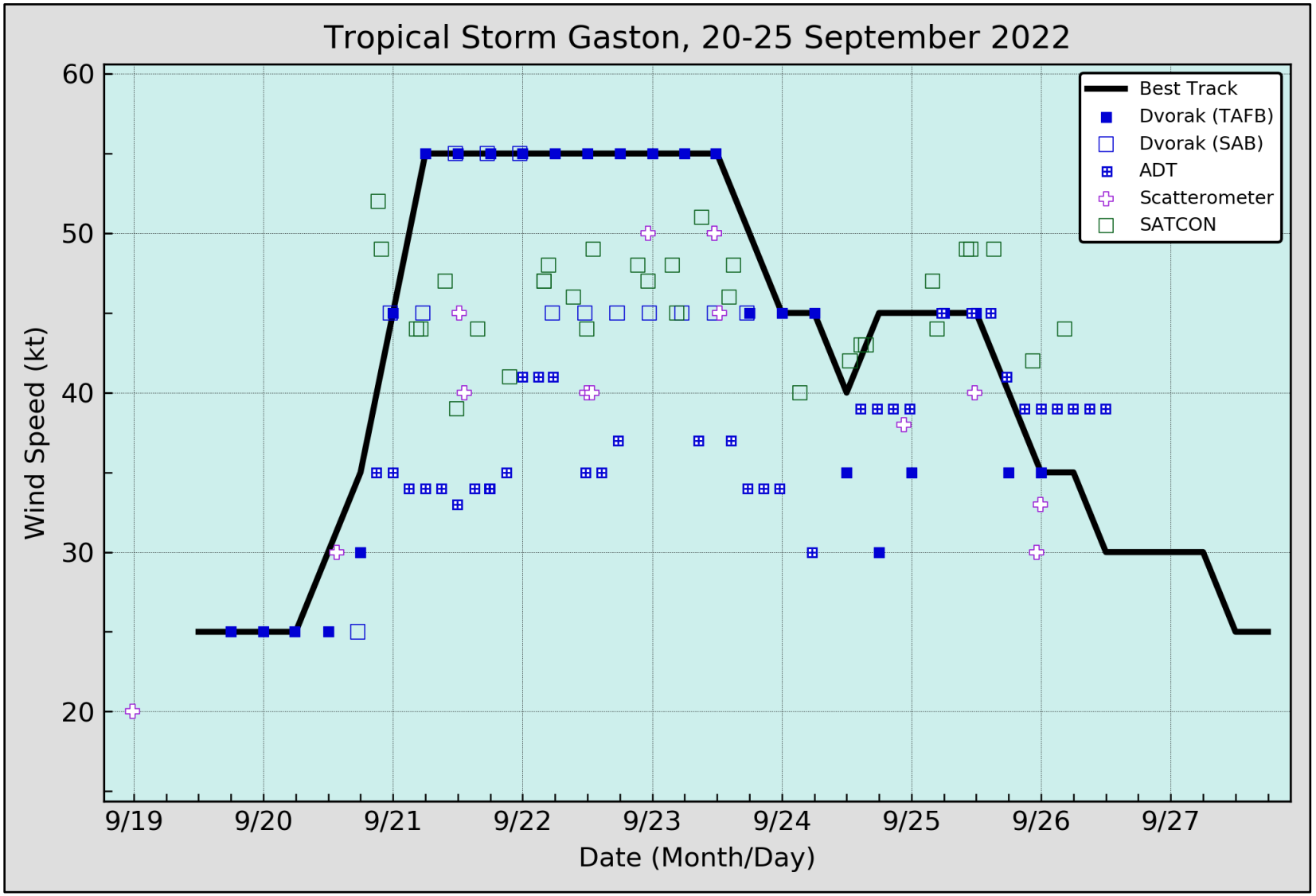

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Gaston, 20–25 September 2022. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

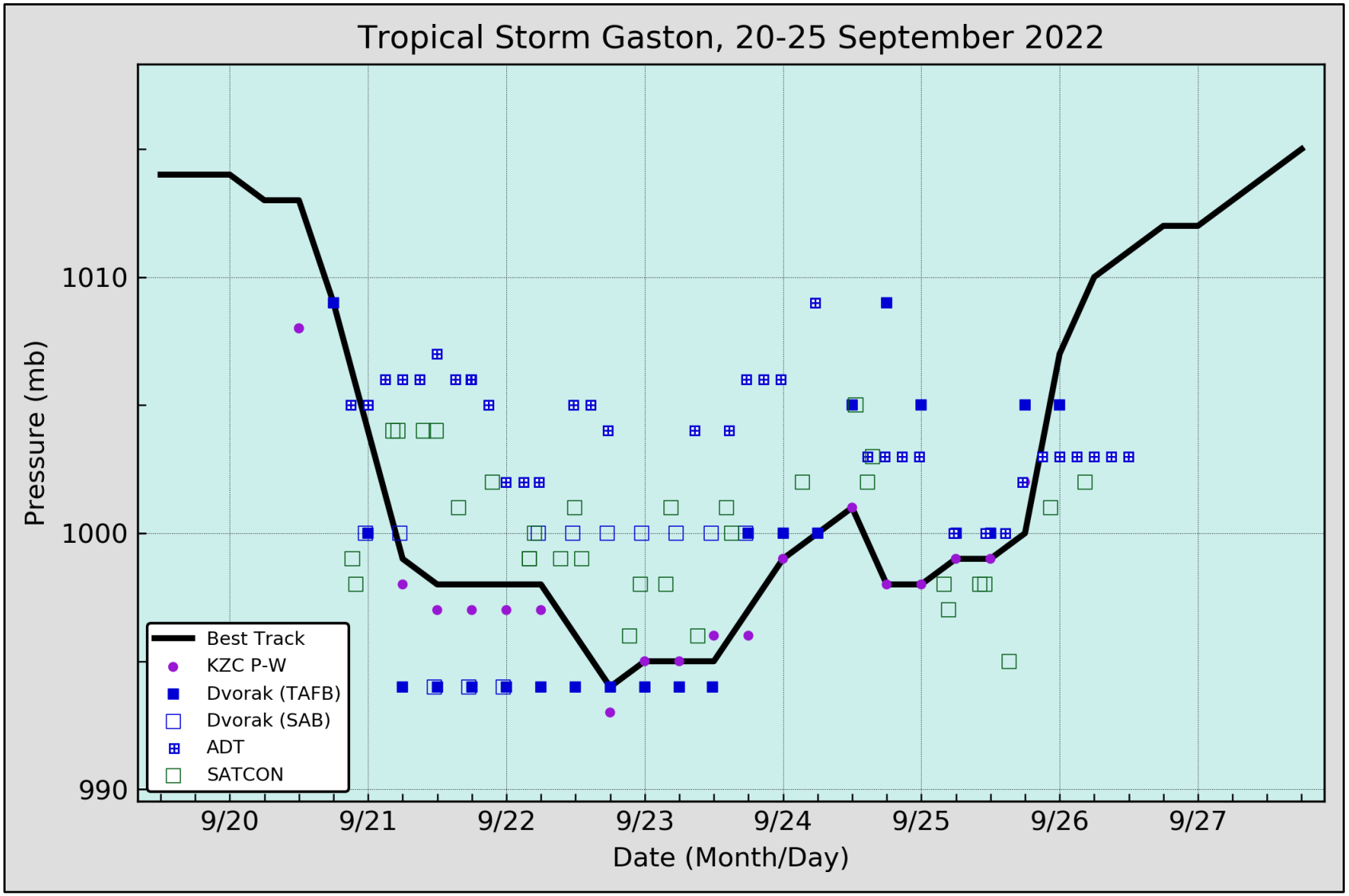

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Gaston, 20–25 September 2022. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for 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.

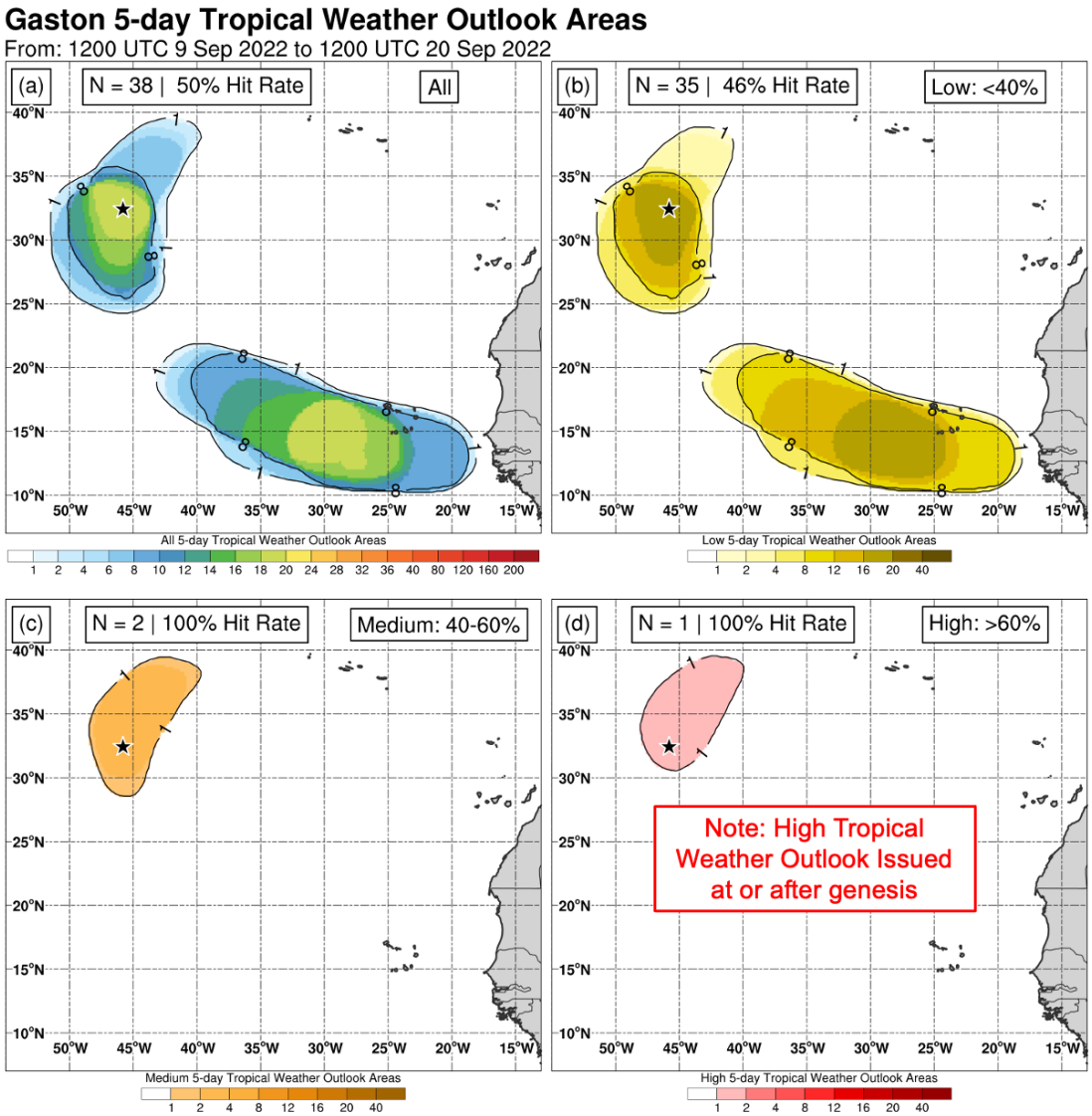

Figure 4. Composites of 5-day tropical cyclone genesis areas depicted in NHC's Tropical Weather Outlooks prior to the formation of Gaston for (a) all probabilistic genesis categories, (b) the low (<40%) category, (c) medium (40–60%) category, and (d) high (>60%) category. The black star in each panel indicates the genesis location of Gaston. The hit rate in each plot indicates the percentage of outlook areas that capture the location of genesis.