NATIONAL HURRICANE CENTER
TROPICAL CYCLONE REPORT

TROPICAL STORM ROSE

(AL172021)

19 – 22 September 2021

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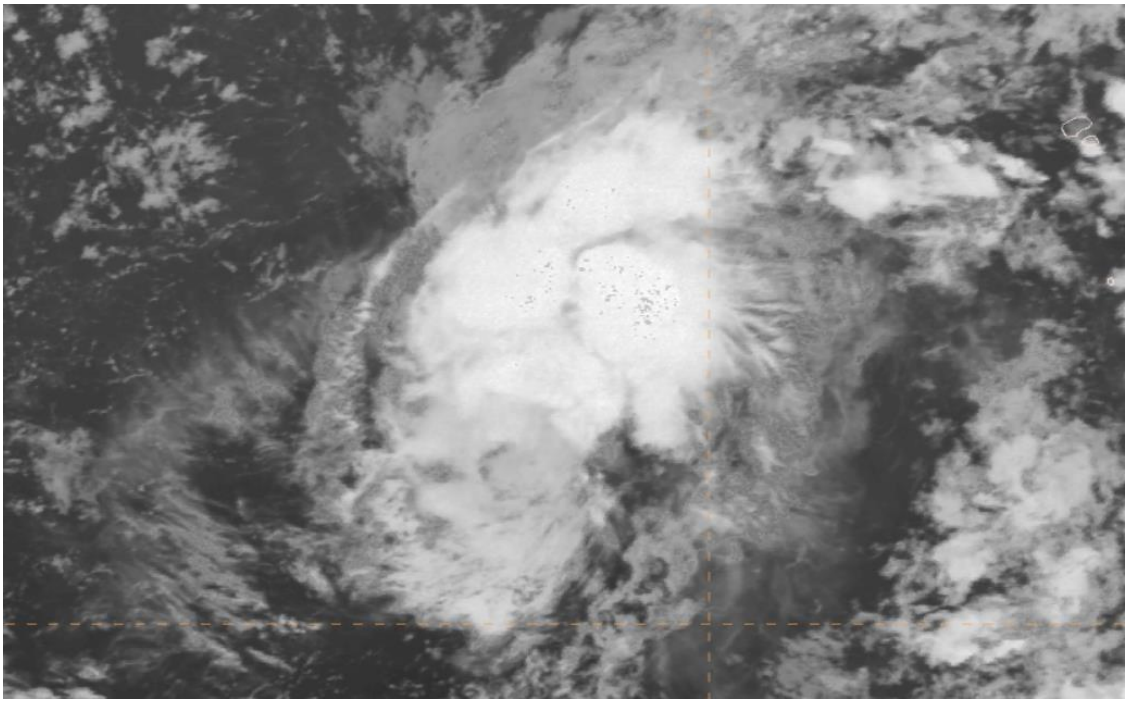

GOES-16 PROXY-VISIBLE SATELLITE IMAGE OF TROPICAL STORM ROSE AT 2330 UTC 20 SEPTEMBER 2021, NEAR PEAK INTENSITY

Rose was a short-lived tropical storm that moved northwestward over the eastern Atlantic Ocean, with no deaths or significant impacts noted.

Tropical Storm Rose

19 – 22 SEPTEMBER 2021

SYNOPTIC HISTORY

Rose developed from a tropical wave that moved off the coast of west Africa early on 16 September, accompanied by a large area of deep convection. While the thunderstorm activity waned by late that day, the system already had a broad low-level circulation, elongated from north-northeast to south-southwest. On 17 September, the southwestern portion of the circulation regained some convection, as well as rudimentary banding features. Bursts of deep convection on 18 September caused the low-level circulation to tighten up, and scatterometer data late that day indicated the system was becoming better defined. It is estimated that a tropical depression formed by 0000 UTC 19 September while located about 325 n mi south-southwest of the Cabo Verde Islands. 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].

Easterly vertical wind shear and drier air in the eastern part of the circulation initially prevented much intensification of the depression, but the system became a tropical storm 18 h after formation. Rose reached a region of lower shear on 20 September while it continued moving northwestward around the eastern Atlantic subtropical ridge. The tropical storm then quickly intensified to a peak of 50 kt at 0000 UTC 21 September, as suggested by scatterometer and satellite estimates. However, vertical wind shear increased markedly that day due to an encroaching upper-level trough, and microwave data (not shown) indicated that the low- and mid-level circulations of the storm decoupled. Thus, Rose rapidly lost strength, becoming a 35-kt tropical storm only 12 h after reaching peak intensity. The strong shear continued, and the low-level center became exposed late on 21 September. This structure led to Rose decaying into a tropical depression by 0600 UTC the next day. Shortly thereafter, all of the associated convection dissipated, and Rose degenerated into a remnant low by 1200 UTC September 22 while located about 850 n mi west-northwest of the Cabo Verde Islands. The low continued moving northwestward that day, and turned northward on 23 September before opening up into a trough of low pressure early the next day.

METEOROLOGICAL STATISTICS

Observations in Rose (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and Satellite Analysis

[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.

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 Rose.

Rose's estimated peak intensity of 50 kt at 0000 UTC 21 September is based on a blend of scatterometer data, accounting for undersampling from the coarse-resolution instrument, and higher satellite estimates from the ADT and TAFB. This peak is also coincident with limited microwave data that showed a short-lived mid-level eye feature.

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

The genesis forecasts for Rose were poor (Table 2). Although Rose's potential formation was mentioned in the 5-day outlook 96 h before genesis occurred, the probabilities for the 2- and 5-day Tropical Weather Outlook did not reach the medium (40-60%) category until 12 h prior to formation. As illustrated in Fig. 4, NHC depicted a low chance of genesis for many outlooks. However, the genesis areas were biased to the northeast, and Rose formed on the southwestern fringe or outside many of the genesis areas, with most of the NHC forecasts capturing the formation location only in the 24 h prior to genesis. This bias appears to be due to model forecasts (and NHC) anticipating the northern section of the precursor wave as a more likely candidate for formation than the southern portion. While two high (>60%) category outlook areas were issued by NHC (Fig. 4d), these were both issued at or after Rose was assessed to have become a tropical cyclone in the final best track.

A verification of NHC official track forecasts for Rose is given in Table 3a. Official forecast track errors were slightly higher than the mean official errors for the previous 5-year period through 36 h, then slightly below the mean thereafter. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. The official track forecasts (OFCL) were better than almost all of the deterministic models, except for the ECMWF (EMXI) model, and OFCL was just behind the performance of the consensus models. It is notable that the ECMWF was the best single model beyond 12 h, even besting the consensus models, while the GFS really struggled with the track forecast for Rose.

A verification of NHC official intensity forecasts for Rose is given in Table 4a. The official forecast intensity errors were lower or much lower than the mean errors for the previous 5-year

period at all verifying forecast times, with a peak mean error of only 4 kt at 48 h. While these were very good forecasts, Rose was a much easier-to-forecast storm than usual, as indicated by low climatology/persistence (OCD5) errors. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. The NHC intensity forecasts performed better than most of the models, except arguably the HMON model, throughout the forecast period, while the statistical-dynamical models (LGEM/DSHP) had relatively high errors for this storm.

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

Table 1. Best track for Tropical Storm Rose, 19–22 September 2021.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
19 / 0000	10.4	27.4	1008	30	tropical depression
19 / 0600	11.3	27.8	1008	30	"
19 / 1200	12.6	28.4	1008	30	"
19 / 1800	13.8	29.4	1007	35	tropical storm
20 / 0000	14.7	30.6	1007	35	"
20 / 0600	15.6	31.8	1007	35	"
20 / 1200	16.7	32.9	1007	35	"
20 / 1800	17.7	34.1	1006	40	"
21 / 0000	18.8	35.3	1004	50	"
21 / 0600	20.0	36.1	1006	40	"
21 / 1200	21.1	36.7	1007	35	"
21 / 1800	22.1	37.3	1007	35	"
22 / 0000	22.7	37.7	1008	35	"
22 / 0600	23.1	38.1	1009	30	tropical depression
22 / 1200	23.4	38.8	1009	30	low
22 / 1800	23.8	39.7	1010	30	"
23 / 0000	24.2	40.6	1010	30	"
23 / 0600	25.0	41.4	1010	30	"
23 / 1200	26.0	41.9	1010	25	"
23 / 1800	27.0	42.0	1010	25	"
24 / 0000	27.8	42.0	1010	25	"
24 / 0600	28.3	41.7	1010	25	"
24 / 1200					dissipated
21 / 0000	18.8	35.3	1004	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%)	66	96
Medium (40%-60%)	12	12
High (>60%)	0	0

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Rose, 19–22 September 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	25.9	40.8	52.6	**62.1**	**67.5**	**50.0**		
OCD5	48.3	87.8	116.2	153.6	194.3	296.6		
Forecasts	11	9	7	5	3	1		
OFCL (2016-20)	23.9	36.3	49.1	63.9	79.0	94.1	128.1	169.7
OCD5 (2016-20)	45.1	97.2	157.2	216.7	271.1	325.4	414.4	490.0

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Rose, 19–22 September 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	25.9	40.8	52.6	62.1	67.5	50.0		
OCD5	48.3	87.8	116.2	153.6	194.3	296.6		
GFSI	33.1	56.7	79.0	107.1	149.7	154.9		
GFEX	27.8	42.6	53.0	70.0	91.1	66.5		
EMXI	26.5	**31.8**	**33.0**	**45.6**	**46.5**	**12.0**		
HWFI	32.1	49.3	55.6	**50.7**	**52.9**	**27.6**		
HMNI	39.0	59.7	71.4	67.5	73.4	89.7		
CMCI	30.6	52.4	63.0	69.3	79.7	102.2		
NVGI	35.1	82.2	137.5	204.0	249.5	298.5		
AEMI	34.5	57.4	75.0	75.8	81.0	153.8		
HCCA	**23.3**	**35.3**	**39.1**	**48.1**	**62.9**	**40.7**		
TVCN	**25.1**	**39.8**	**51.4**	63.4	79.2	**49.7**		
TVCX	26.1	**37.3**	**48.3**	**57.4**	71.7	**38.6**		
TVDG	26.0	**40.3**	**49.1**	64.5	84.4	55.2		
TABD	43.9	124.4	223.6	309.4	396.9	391.9		
TABM	36.6	93.7	164.1	223.8	290.9	316.0		
TABS	42.0	82.4	120.2	156.6	196.6	232.3		
Forecasts	11	9	7	5	3	1		

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Rose, 19–22 September 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	**3.6**	**3.3**	**3.6**	**4.0**	**3.3**	**0.0**		
OCD5	5.6	6.8	9.3	12.2	13.0	19.0		
Forecasts	11	9	7	5	3	1		
OFCL (2016-20)	5.4	8.0	9.6	10.9	11.5	12.1	13.3	14.5
OCD5 (2016-20)	7.0	11.0	14.3	16.8	18.3	19.7	21.7	23.0

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Rose, 19–22 September 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	3.6	3.3	3.6	4.0	3.3	0.0		
OCD5	5.6	6.8	9.3	12.2	13.0	19.0		
DSHP	4.8	3.6	6.3	8.8	12.7	21.0		
LGEM	5.6	3.6	5.3	5.6	7.0	11.0		
HWFI	6.4	6.2	4.9	**3.2**	5.0	4.0		
HMNI	6.5	5.4	**2.1**	**2.6**	**2.3**	4.0		
IVCN	5.5	4.6	**3.3**	4.2	7.0	11.0		
IVDR	5.7	4.4	**2.9**	**2.6**	5.0	8.0		
HCCA	5.5	4.8	**3.1**	5.4	7.3	9.0		
GFSI	6.4	8.4	10.0	7.6	8.3	12.0		
EMXI	6.3	8.1	8.1	5.2	4.3	1.0		
Forecasts	11	9	7	5	3	1		

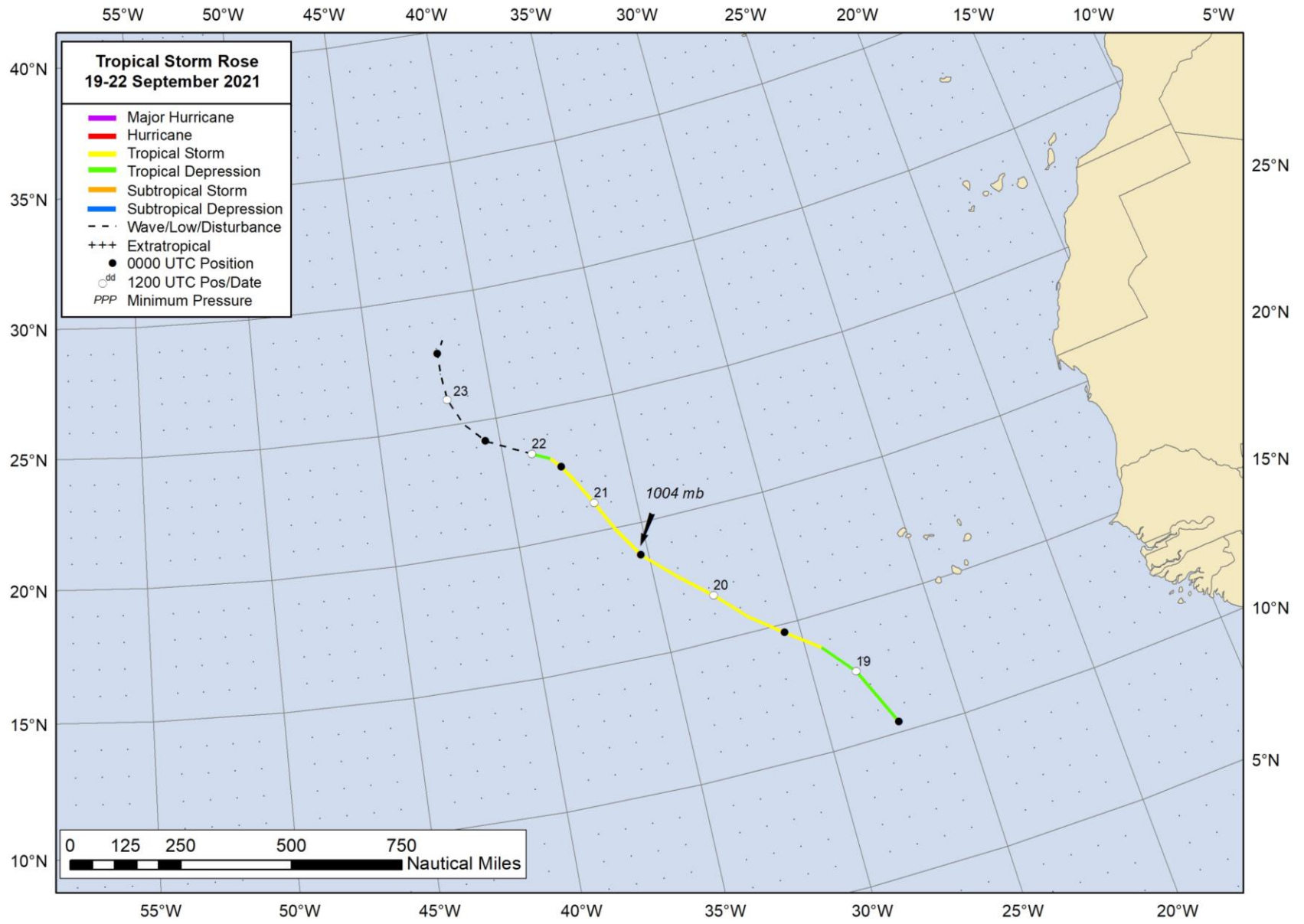

Figure 1. Best track positions for Tropical Storm Rose, 19–22 September 2021.

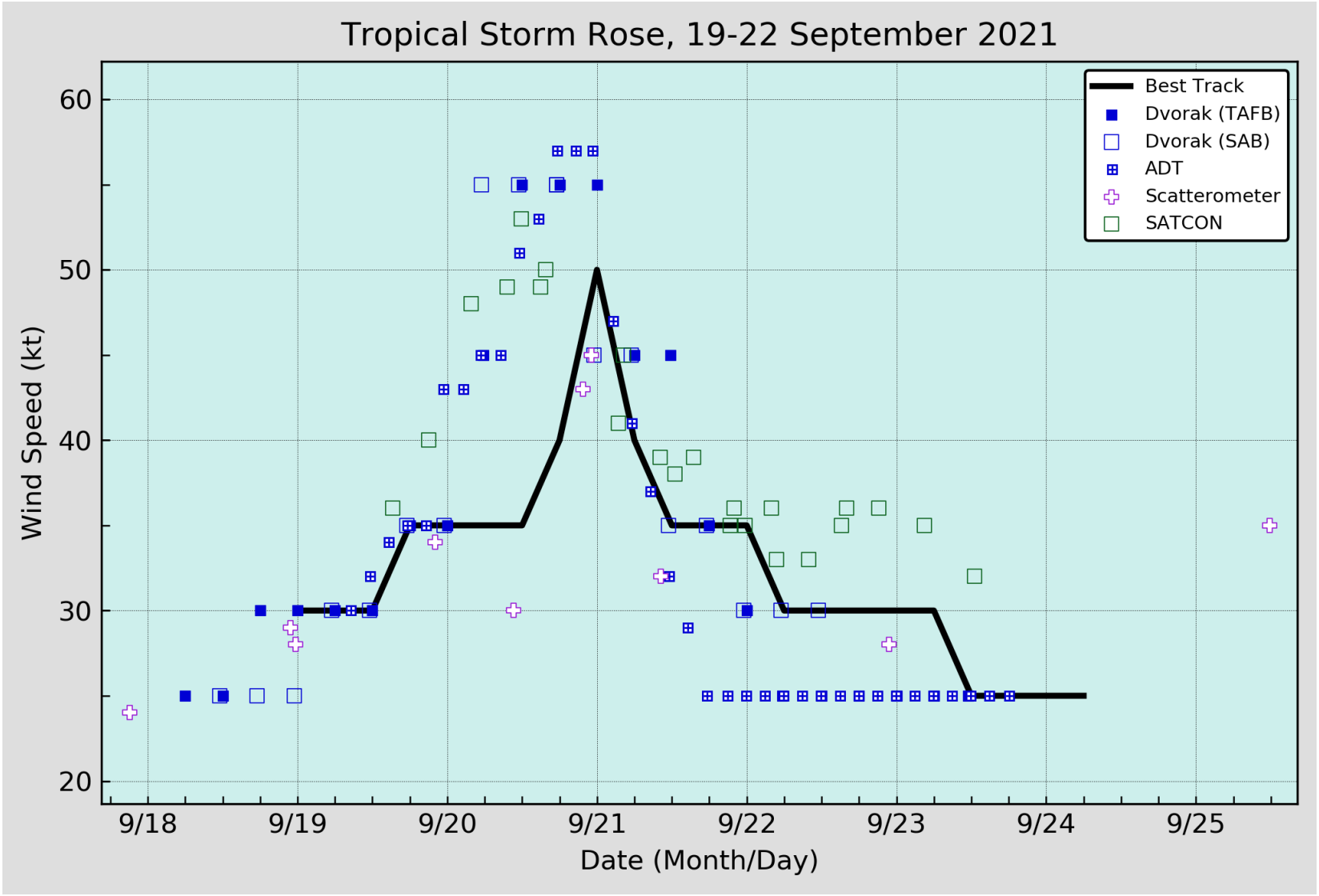

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Rose, 19–22 September 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

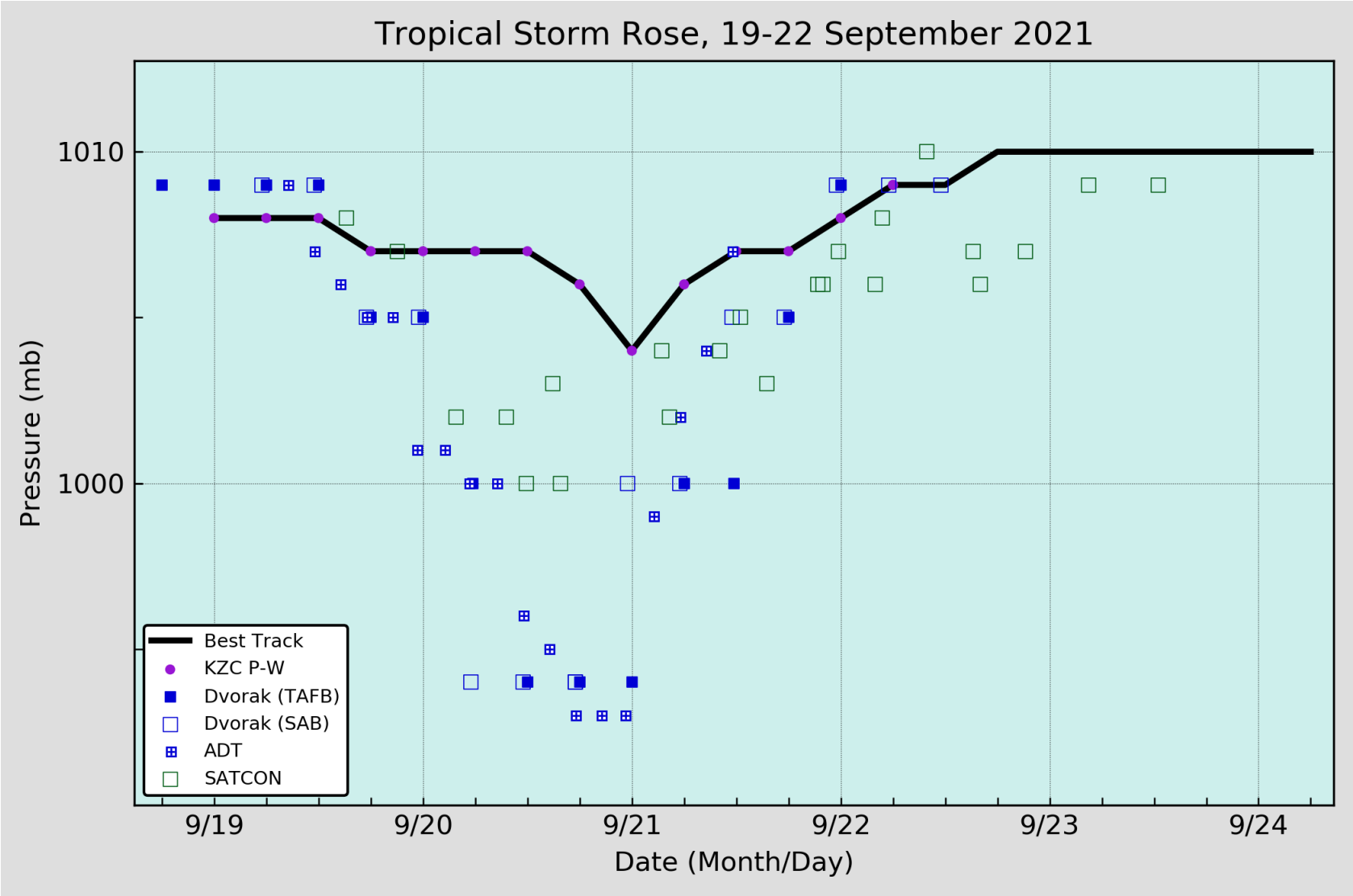

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Rose, 19–22 September 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for 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.

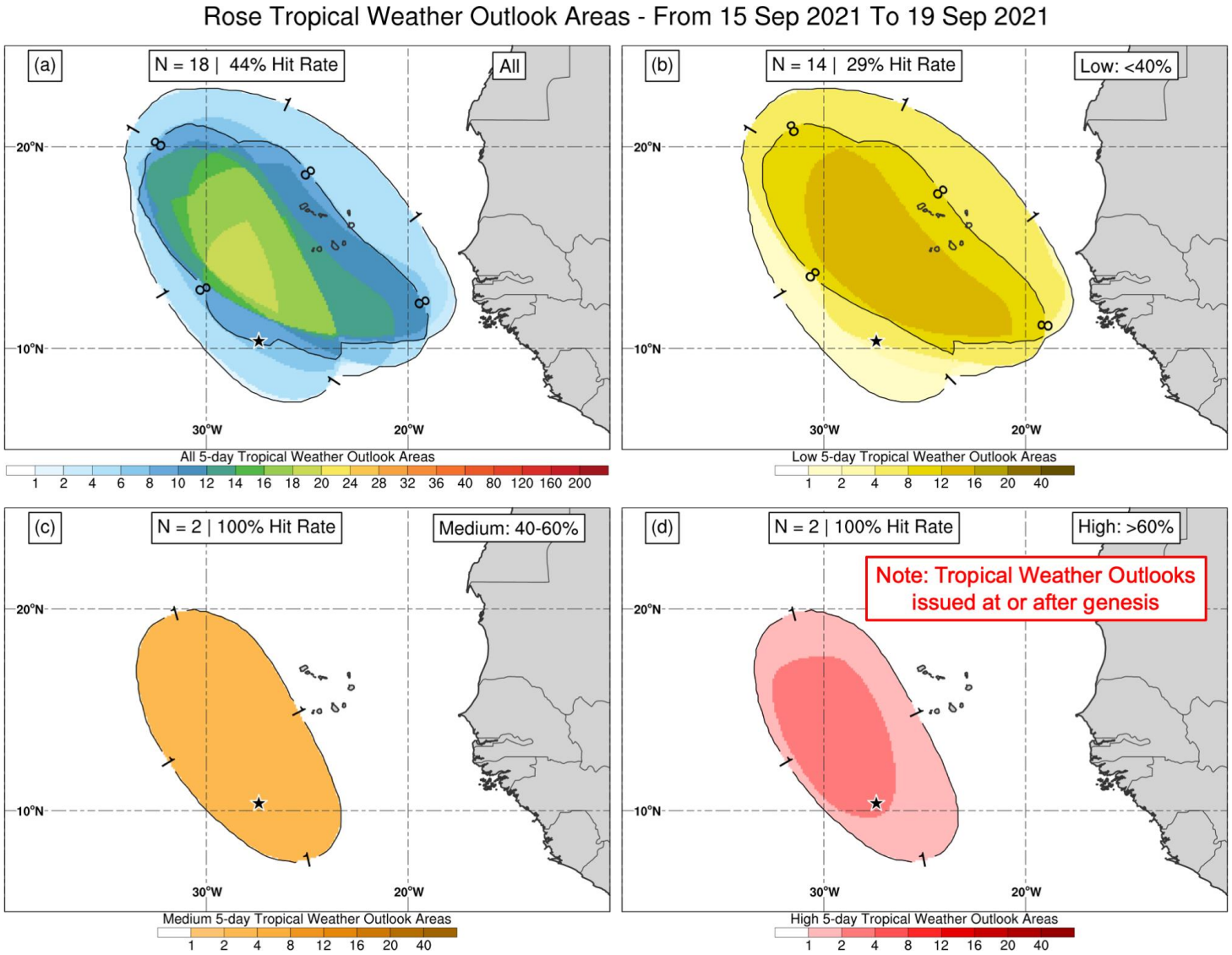

Figure 4. Composites of 5-day tropical cyclone genesis areas depicted in NHC's Tropical Weather Outlooks prior to the formation of Tropical Storm Rose for (a) all probabilistic genesis categories, (b) the low (<40%) category, (c) medium (40–60%) category, and (d) high (>60%) category. Rose's location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