NATIONAL HURRICANE CENTER
TROPICAL CYCLONE REPORT

TROPICAL STORM ANDRES

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9–11 May 2021

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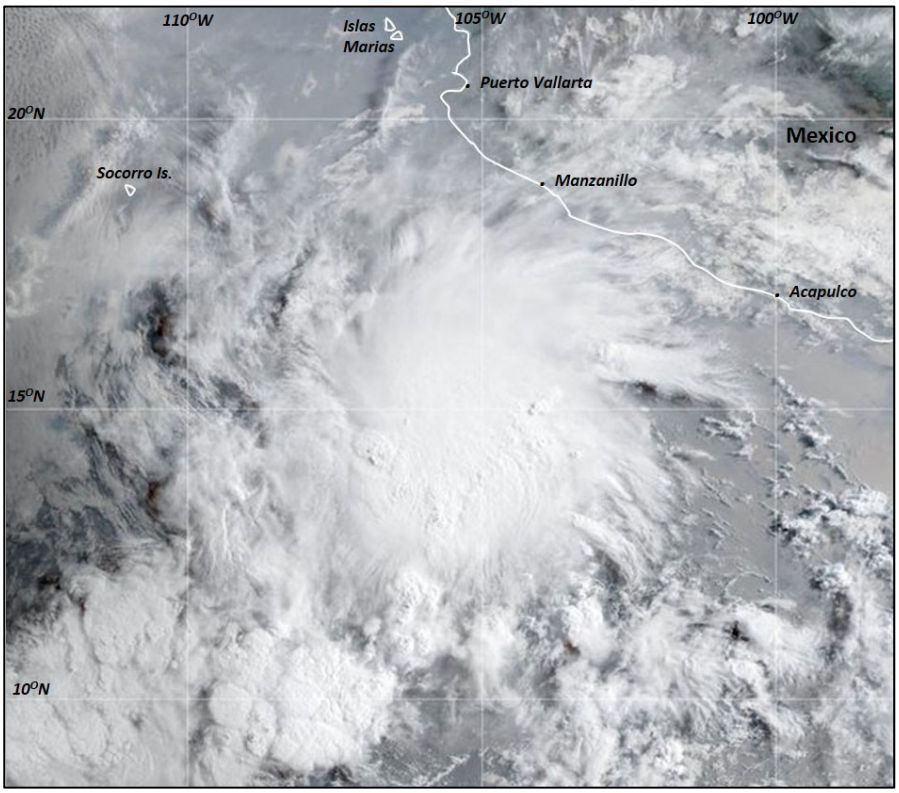

GOES-16 TRUE COLOR VISIBLE SATELLITE IMAGE OF ANDRES SHORTLY AFTER BECOMING A TROPICAL STORM OFF OF THE SOUTHWESTERN COAST OF MEXICO AT 1400 UTC 9 MAY 2021. IMAGE COURTESY NOAA/NESDIS/STAR.

Andres was a short-lived tropical storm that formed due to the complex interaction between an eastward-moving Kelvin wave and a Gulf of Tehuantepec gap wind event. The cyclone formed well offshore of the southwestern coast of Mexico and remained over the open eastern North Pacific Ocean throughout its lifetime. Andres was the earliest formation of a tropical storm on record in the basin, besting the previous mark held by Adrian of 2017.

Tropical Storm Andres

9–11 MAY 2021

SYNOPTIC HISTORY

Andres did not originate from a tropical wave. The incipient disturbance from which the tropical cyclone formed appears to have been initiated by an eastward-moving convectively coupled Kelvin wave (CCKW) that enhanced the eastern North Pacific monsoon trough south of the south-central coast of Mexico during 2–3 May (Fig. 1). The broad disturbance moved slowly eastward over the next few days as a surface trough beneath a weak closed low at the 850-mb level (Fig. 2). On 5 May, the system slowed down and briefly became stationary before turning westward by early on 6 May after it began to interact with a Gulf of Tehuantepec easterly gap-wind event (Fig. 2). The increased easterly flow on the north side of the surface trough resulted in the development of a broad and ill-defined low-pressure system on 7 May a few hundred n mi south of the southern coast of Mexico. Intrusions of dry mid-level air, likely caused by sinking motion that was present in the wake of the CCKW (Fig. 1), in conjunction with modest easterly deep-layer vertical wind shear, hindered the development of persistent convection during the following day or so while the system moved slowly west-northwestward parallel to the southern and southwestern coasts of Mexico. On 8 May, a series of small convective bursts near and just to the northeast of the ill-defined center caused the inner-core wind field to gradually improve, and by 0600 UTC 9 May associated thunderstorm activity had increased and become organized enough for the low to be classified as a tropical depression when it was located about 350 n mi south-southeast of Socorro Island. The cyclone strengthened into a tropical storm 6 h later (cover photo). The “best track” chart of the tropical cyclone’s path is given in Fig. 3, with the wind and pressure histories shown in Figs. 4 and 5, respectively. The best track positions and intensities are listed in Table 1[1].

Andres moved northwestward early on 9 May and then turned north-northwestward later that day as the 35-kt tropical storm was steered around the western periphery of a weak subtropical ridge that extended from the southwestern Gulf of Mexico westward across central Mexico and into the eastern North Pacific. Westerly mid-level vertical wind shear of 15–20 kt kept most of the associated deep convection displaced to the northeast and east of the center on 9–10 May, which hindered strengthening. By late on 10 May, southwesterly deep-layer shear increased to more than 30 kt, causing Andres to weaken to a tropical depression by 1800 UTC that day when the cyclone was located about 200 n mi south-southeast of Socorro Island. The depression turned westward and continued to weaken as it moved over cooler sea-surface temperatures and into a drier and more stable air mass. By 0600 UTC 11 May, all thunderstorm activity had dissipated and Andres degenerated into a remnant low about 175 n mi southwest of

[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.

Socorro Island. The low turned west-southwestward early on 12 May and maintained that motion until it dissipated by 1800 UTC that day several hundred n mi southwest of Socorro Island.

METEOROLOGICAL STATISTICS

Observations in Andres (Figs. 4 and 5) 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 of Andres.

There were no ship or buoy reports of tropical-storm-force winds associated with Andres.

Andres' estimated peak intensity of 35 kt is based on subjective Dvorak satellite intensity estimates of T2.5/35 kt from TAFB and SAB, and UW-CIMSS objective intensity estimates of 35–38 kt from ADT and 35 kt from SATCON. The estimated minimum pressure of 1005 mb is based on the KZC pressure-wind relationship.

Andres was the earliest eastern North Pacific tropical storm to develop on record, besting the previous mark by only 12 h that had been held by Adrian of 2017, which formed at 1800 UTC 9 May.

CASUALTY AND DAMAGE STATISTICS

There were no reports of damage or casualties associated with Tropical Storm Andres.

FORECAST AND WARNING CRITIQUE

The genesis of Andres was forecast fairly well for an out-of-season tropical cyclone. Table 2 provides the number of hours in advance of formation associated with the first NHC Special Tropical Weather Outlook (TWO) forecast in each likelihood category. A Special TWO was first issued on the morning of 7 May, 39 h before genesis occurred, giving the system a medium (40–60%) chance of tropical cyclone formation in both the 2-day and 5-day periods. The 48-h and 120-h chances of formation were subsequently raised to the high category (>60%) 24 h and 28 h, respectively, before genesis.

A verification of NHC official track forecasts for Andres is given in Table 3a. Although the sample size is small due to Andres' relatively short lifetime, official forecast (OFCL) track errors were lower than the mean official errors for the previous 5-yr period at the 24- and 36-h forecast times. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. OFCL track forecasts were comparable to or better than the available NHC track model guidance.

A verification of NHC official intensity forecasts for Andres is given in Table 4a. Although the sample size is small, it is worth noting that NHC forecast intensity errors were significantly lower than the mean official errors for the previous 5-yr period at all available forecast times, ranging from 70% to 85% better than average. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. OFCL intensity errors were lower than all of the available intensity guidance at all times, with the exception of the GFSI (interpolated GFS) model, which slightly outperformed the NHC intensity forecasts at 36 h.

No coastal watches and warnings were required with Andres.

Acknowledgements

Special thanks to Senior Hurricane Specialist John Cangialosi for producing the "best track" map (Fig. 3).

Table 1. Best track for Tropical Storm Andres, 9–11 May 2021.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
08 / 1200	12.7	105.6	1009	25	low
08 / 1800	12.9	106.4	1008	25	"
09 / 0000	13.1	107.0	1007	25	"
09 / 0600	13.4	107.5	1006	30	tropical depression
09 / 1200	13.7	107.9	1005	35	tropical storm
09 / 1800	14.0	108.3	1005	35	"
10 / 0000	14.4	108.7	1005	35	"
10 / 0600	14.8	109.0	1005	35	"
10 / 1200	15.3	109.3	1005	35	"
10 / 1800	15.7	109.7	1006	30	tropical depression
11 / 0000	15.8	110.1	1007	25	"
11 / 0600	15.9	110.6	1007	25	low
11 / 1200	15.9	111.1	1008	20	"
11 / 1800	15.9	111.7	1009	20	"
12 / 0000	15.9	112.4	1009	20	"
12 / 0600	15.9	113.1	1009	20	"
12 / 1200	15.7	114.0	1009	20	"
12 / 1800					dissipated
09 / 1200	13.7	107.9	1005	35	minimum pressure

Table 2. Number of hours in advance of formation of Andres 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%)	–	–
Medium (40%-60%)	39	39
High (>60%)	24	28

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Andres, 9–11 May 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	25.6	**29.6**	**32.3**					
OCD5	34.1	63.2	90.9					
Forecasts	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)	34.1	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 Andres, 9–11 May 2021. 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	26.1	29.6	32.3					
OCD5	38.3	63.2	90.9					
GFSI	28.4	**26.2**	**26.3**					
EMXI	26.4	**25.0**	40.5					
NVGI	41.5	85.9	142.9					
CMCI	40.6	39.7	64.1					
AEMI	33.5	30.7	39.7					
HWFI	46.9	63.8	62.4					
HMNI	28.5	40.5	38.1					
CTCI	28.8	**29.1**	39.6					
TVCA	26.2	**28.6**	38.7					
GFEX	**25.9**	**18.1**	**32.0**					
TVCX	27.2	**28.6**	38.7					
HCCA	26.4	32.8	49.4					
TABS	29.5	33.3	45.6					
TABM	27.0	35.5	63.1					
TABD	43.2	90.1	169.2					
Forecasts	5	4	2					

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Andres, 9–11 May 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	**1.7**	**1.2**	**2.5**					
OCD5	4.2	8.2	14.5					
Forecasts	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 Andres, 9–11 May 2021. 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	1.0	1.2	2.5					
OCD5	3.0	8.2	14.5					
HWFI	3.0	3.2	5.0					
HMNI	2.4	3.5	3.5					
DSHP	1.8	2.8	4.0					
LGEM	2.0	2.2	4.0					
ICON	1.4	2.0	3.0					
IVCN	1.6	2.0	3.5					
CTCI	2.0	1.5	4.0					
GFSI	2.6	1.2	**2.0**					
EMXI	3.2	3.2	4.0					
HCCA	1.6	2.0	5.0					
Forecasts	5	4	2					

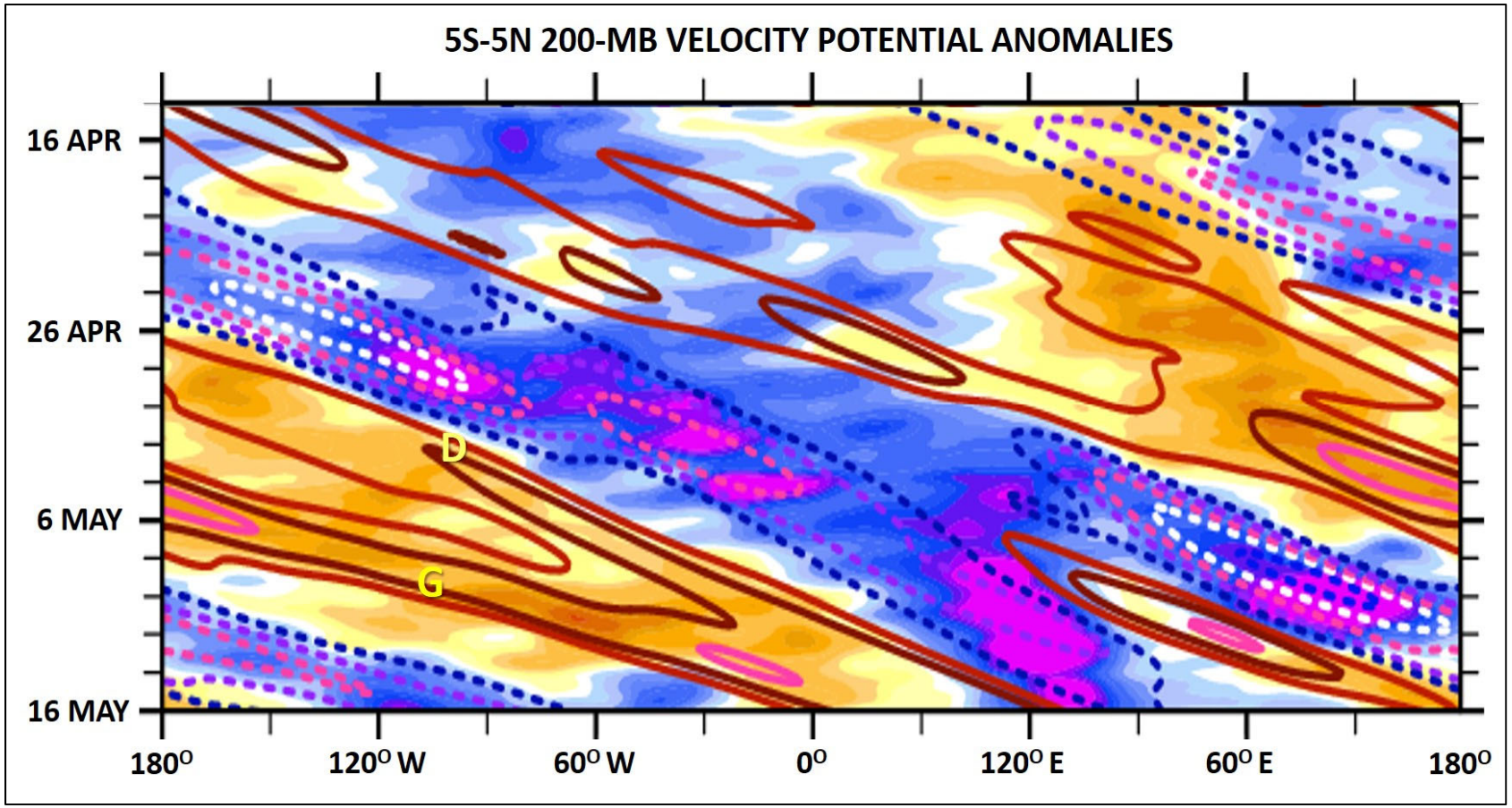

Figure 1. Plot of GFS model 200-mb velocity potential anomalies during the period 15 April to 16 May 2021. Blue and pink (yellow and brown) regions correspond to areas of upper-level divergence (convergence) that are favorable (unfavorable) for tropical cyclones to form. The yellow D marks the time that the Andres pre-genesis disturbance formed and the yellow G marks when tropical cyclogenesis occurred. Data plot courtesy of Michael Ventrice, SUNY-Albany.

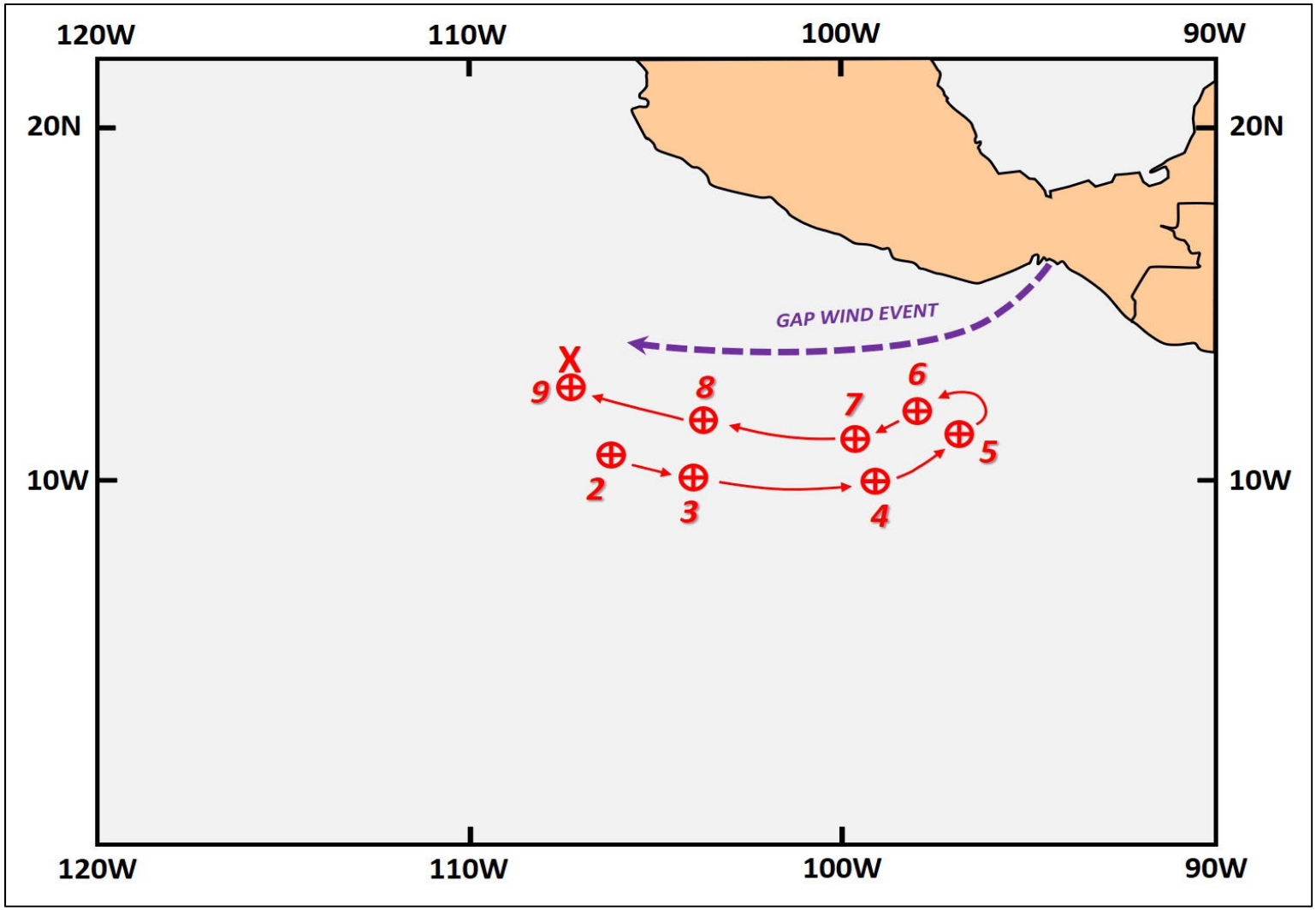

Figure 2. Plot of 0000 UTC positions of the GFS 850-mb vorticity centers (red circled-X) associated with the Tropical Storm Andres' pre-genesis disturbance during the period 2–9 May 2021. Red numerals denote the date and the red-X marks the location of Andres' genesis at 0600 UTC 9 May. The purple dashed-line marks the position of a Gulf of Tehuantepec gap-wind event that aided in the development of a surface-to-850-mb low pressure system during the period 6–9 May.

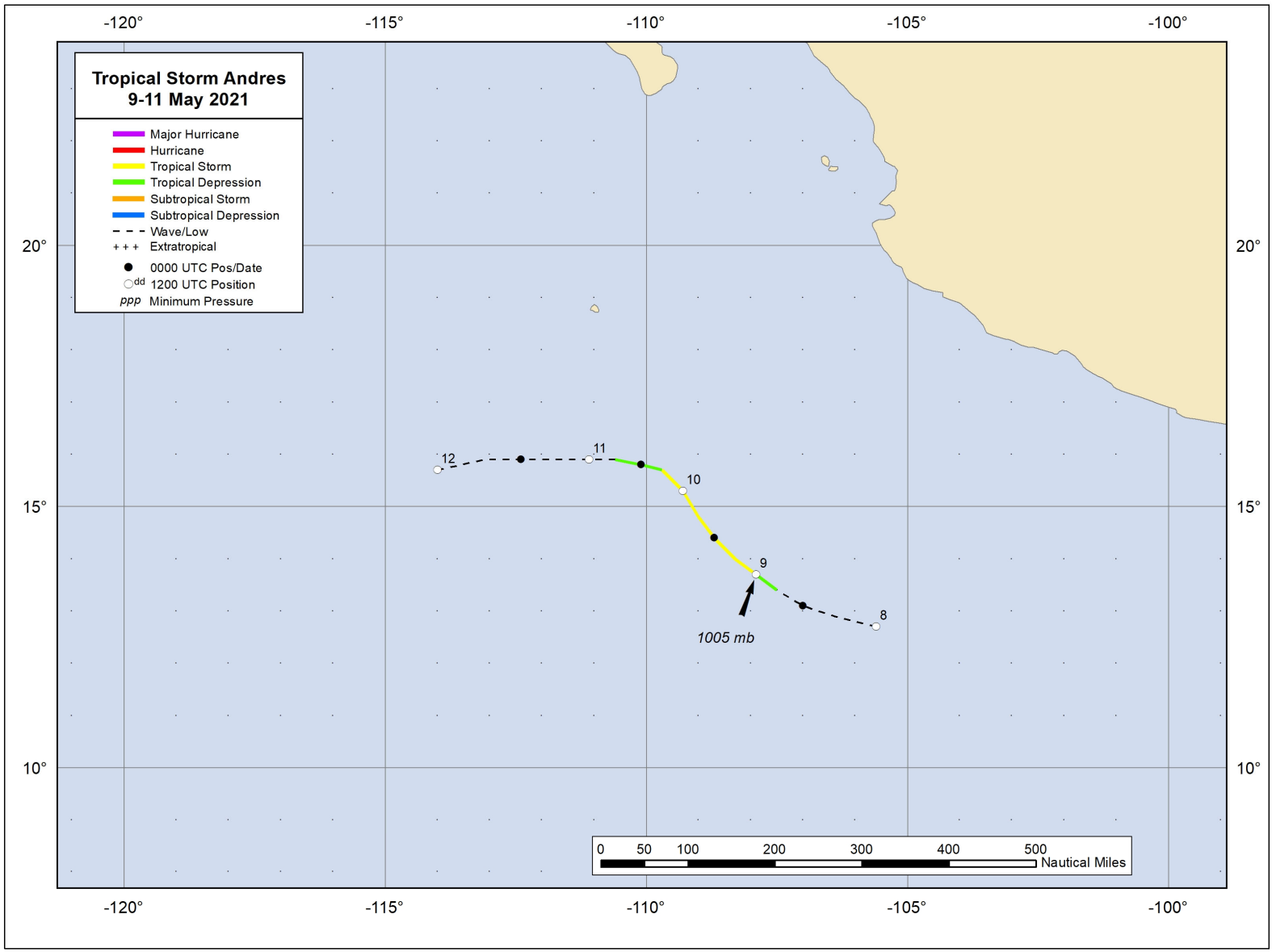

Figure 3. Best track positions for Tropical Storm Andres, 9–11 May 2021.

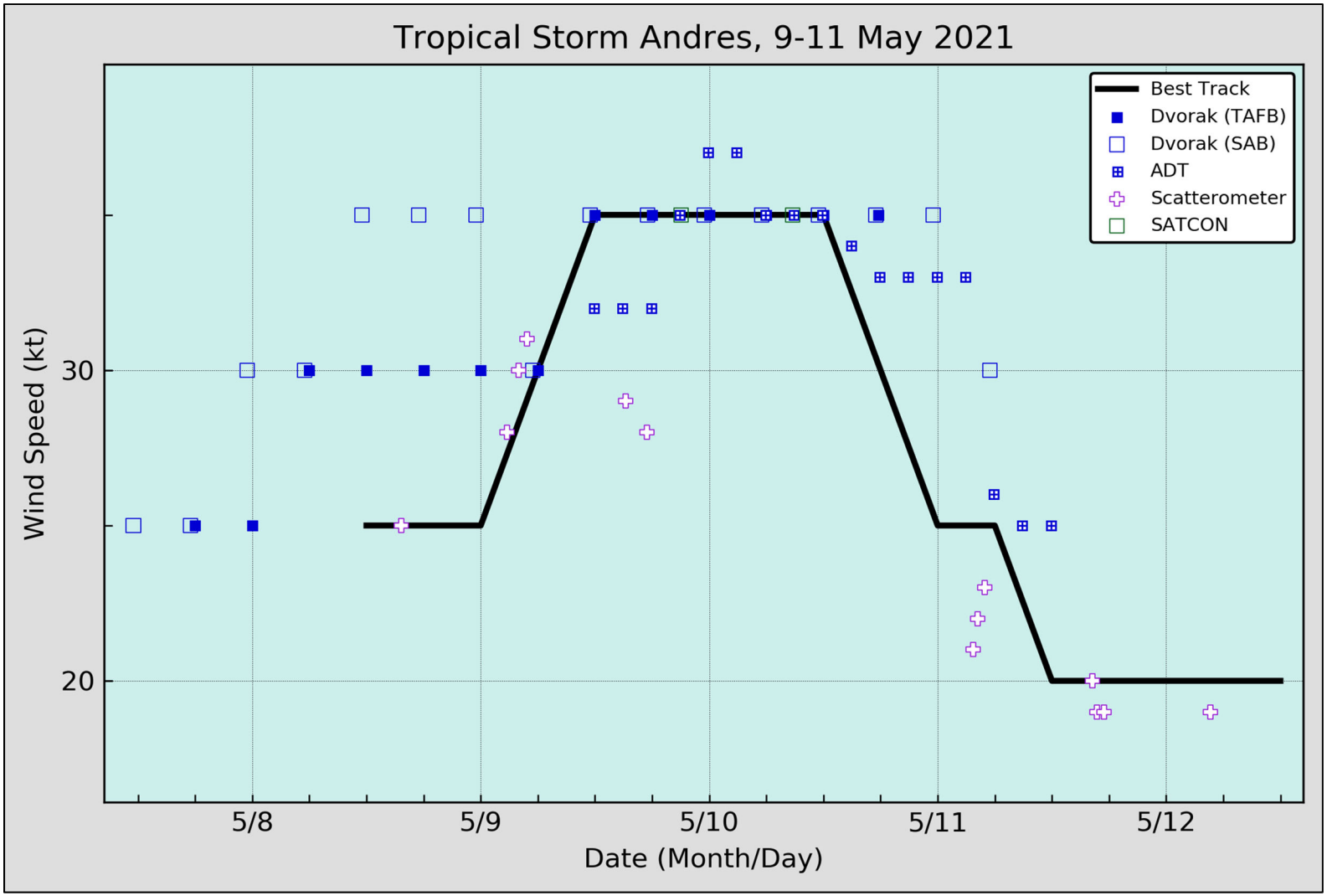

Figure 4. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Andres, 9–11 May 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

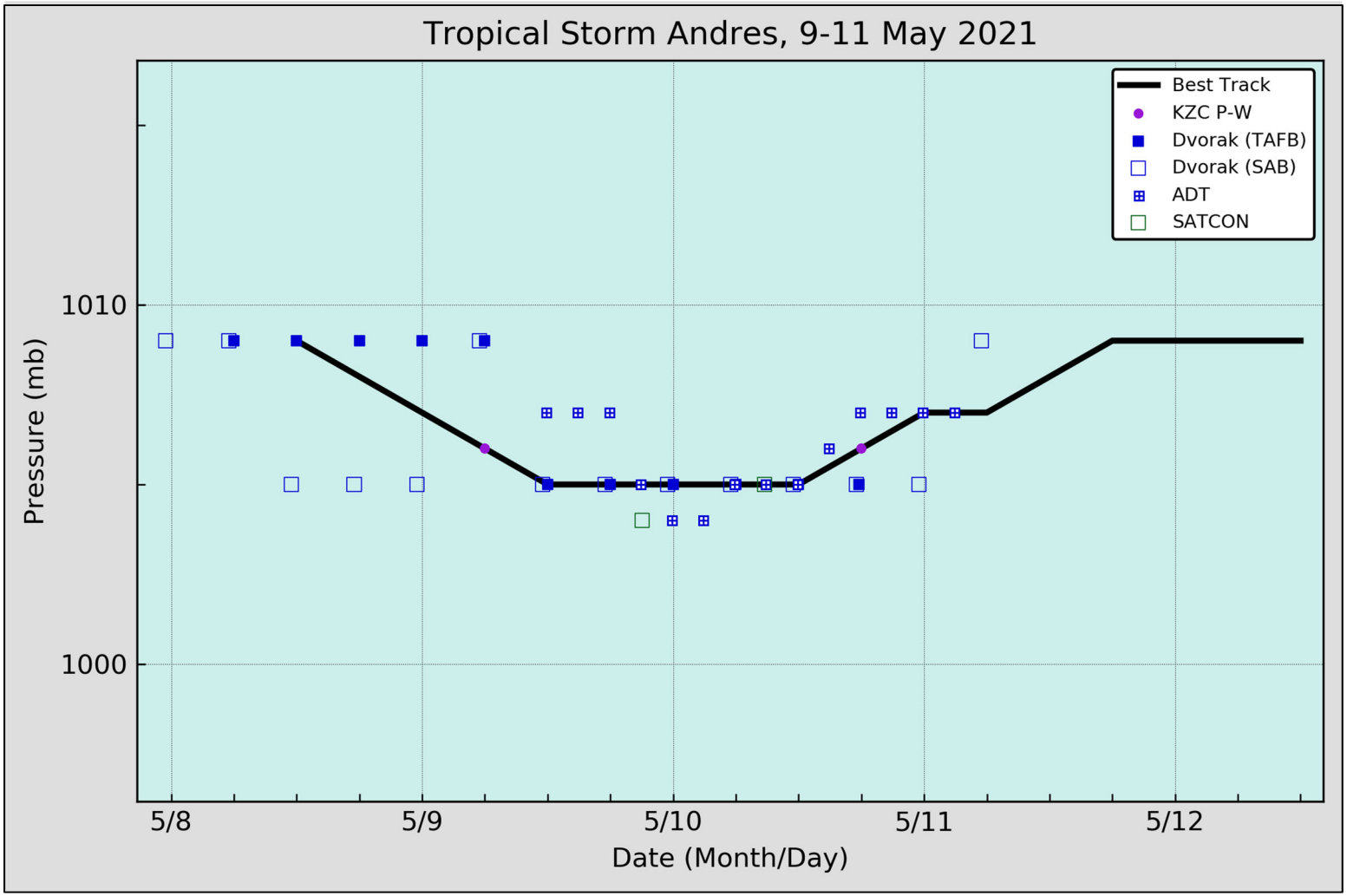

Figure 5. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Andres, 9–11 May 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological 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.