

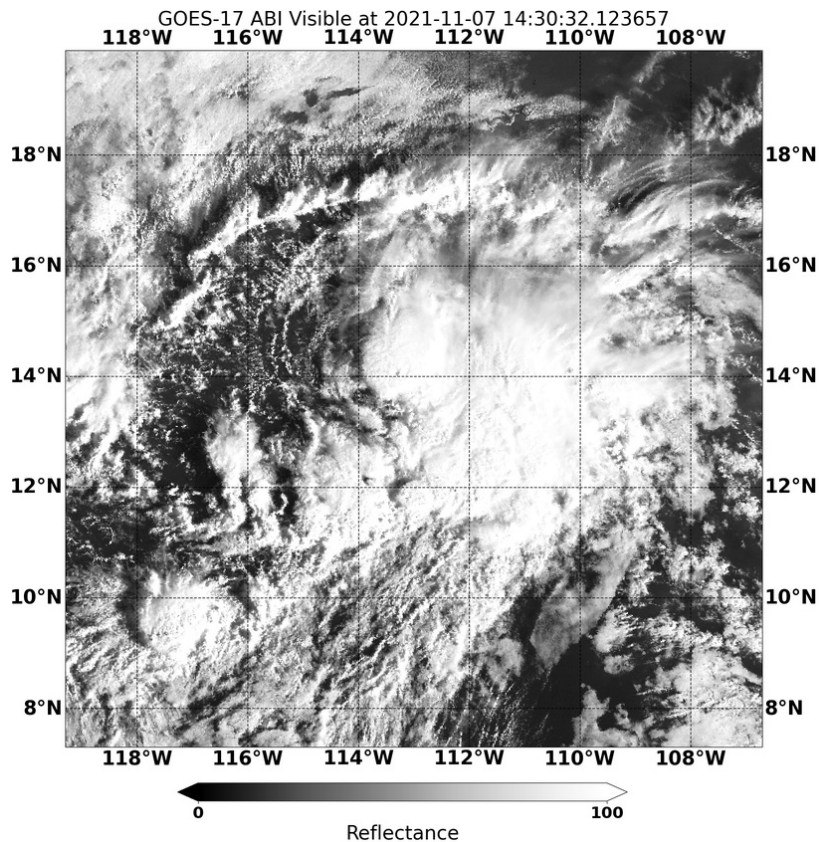


NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

TROPICAL STORM SANDRA (EP192021)

7–9 November 2021

Richard J. Pasch
National Hurricane Center
14 March 2022



GOES-17 VISIBLE IMAGE OF TROPICAL STORM SANDRA AT 1430 UTC 7 NOVEMBER 2021. IMAGE COURTESY OF THE NAVAL RESEARCH LABORATORY.

Sandra was a short-lived late-season tropical storm in the eastern North Pacific basin that did not affect land.

Tropical Storm Sandra

7–9 NOVEMBER 2021

SYNOPTIC HISTORY

Sandra does not appear to have originated from a tropical wave that moved from Africa. Instead, the system was first noted as a disturbance within a zonally-elongated area of low pressure to the south of eastern Mexico around 1 November. The system moved westward to west-northwestward to the south of mainland Mexico for a few days while producing disorganized cloudiness, showers, and thunderstorms over a broad area. On 5–6 November, deep convection became more consolidated and gradually became better organized a few hundred n mi south-southwest of Manzanillo, Mexico. Around 0600 UTC 7 November, the system's circulation was sufficiently well defined with enough organized deep convection, to signify the formation of a tropical depression while centered about 590 n mi south-southwest of Cabo San Lucas, Mexico. 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 1¹.

In an environment of only marginally conducive upper-level winds, but sufficiently warm sea surface temperatures and adequate mid-level moisture, the depression strengthened slightly, and became a tropical storm by 1200 UTC 7 November. Southwesterly shear associated with a broad upper-level trough near 130–135°W soon caused the low-level center of the storm to be displaced to the west of the main area of deep convection. Sandra moved generally west-northwestward for the next day or so on the southern side of a mid-level ridge. The tropical cyclone changed little in organization during this time, with the center situated near the western edge of the main convective canopy. The system eventually weakened to a tropical depression around 1800 UTC 8 November. On 9 November, persistent shear and dry air caused Sandra to lose most of its associated deep convection. By 1800 UTC that day it degenerated into a swirl of low clouds, i.e. a remnant low, centered about 850 n mi southwest of Cabo San Lucas. The shallow low turned westward at an increasing forward speed within the low-level flow, and finally opened up into a trough early on 10 November.

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 *bt* directory, while previous years' data are located in the *archive* directory.

METEOROLOGICAL STATISTICS

Observations in Sandra (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 of Sandra.

The analyzed 35-kt maximum intensity of Sandra is based on Dvorak estimates from both SAB and TAFB along with data from an ASCAT pass. Sandra's estimated minimum pressure of 1005 mb is based on Dvorak classifications from SAB and TAFB.

No ship reports of winds of tropical storm force associated with Sandra were received.

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

The genesis of Sandra was anticipated rather well in advance. It was first mentioned in the Tropical Weather Outlook 132 h prior to development that an area of low pressure was expected to form in a few days several hundred miles south of the southwestern coast of Mexico, and the formation probability was set to low (<40%), as indicated in Table 2. A 2-day genesis probability, in the low category, was first assigned 84 h before formation, at which time the 5-day probability was increased to medium (40%–60%). The 2-day genesis probability was moved into the medium category 60 h prior to genesis. Both the 2-day and 5-day formation probabilities were boosted to high (>60%) 36 h prior to genesis.

A verification of NHC official track forecasts for Sandra is given in Table 3a. Official track forecast errors were comparable to or a little higher than the mean official errors for the previous 5-yr period. There were very few cases to verify however, with no cases beyond 48 h. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. For this limited number of cases, the mean official track errors were lower than or comparable to those of the numerical guidance. The consensus aid, TVCE, was mainly the best performer.



A verification of NHC official intensity forecasts for Sandra is given in Table 4a. With few cases to verify, and no cases beyond 48 h, the mean official intensity forecast errors were below the mean official errors for the previous 5-yr period. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. The official intensity errors were lower than or comparable to all of the models for a limited sample size, with the Decay-Statistical Hurricane Intensity Prediction Scheme (DSHP) performing better than the other intensity models.

The official intensity forecasts correctly indicated that Sandra would be short-lived and degenerate into a remnant low around the correct time.

Watches or warnings for land areas were not required for Sandra.

ACKNOWLEDGMENTS

John P. Cangialosi made the track map.



Table 1. Best track for Tropical Storm Sandra, 7–9 November 2021.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
07 / 0600	13.3	112.4	1007	30	tropical depression
07 / 1200	13.5	113.5	1006	35	tropical storm
07 / 1800	13.8	114.6	1006	35	"
08 / 0000	14.1	115.5	1005	35	"
08 / 0600	14.2	116.1	1006	35	"
08 / 1200	14.4	116.6	1006	35	"
08 / 1800	14.9	117.3	1008	30	tropical depression
09 / 0000	15.1	118.2	1008	30	"
09 / 0600	15.0	119.1	1009	25	"
09 / 1200	14.7	120.1	1010	25	"
09 / 1800	14.4	121.5	1010	25	low
10 / 0000	14.1	123.0	1010	25	"
10 / 0600					dissipated
08 / 0000	14.1	115.5	1005	35	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%)	84	132
Medium (40%-60%)	60	84
High (>60%)	36	36

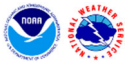


Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Sandra, 7–9 November 2021. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)							
	12	24	36	48	60	72	96	120
OFCL	32.0	31.6	50.2	79.2				
OCD5	56.9	64.1	80.2	148.6				
Forecasts	7	5	3	1				
OFCL (2016-20)	21.3	33.1	44.0	54.6	65.3	76.0	95.9	116.6
OCD5 (2016-20)	33.1	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 Sandra, 7–9 November 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	32.0	31.6	50.2	79.2				
OCD5	56.9	64.1	80.2	148.6				
GFSI	38.3	39.4	68.0	137.6				
HWFI	34.7	48.5	51.1	88.8				
HMNI	41.1	53.7	75.3	72.4				
EMXI	37.0	45.6	72.1	79.9				
CMCI	44.4	50.3	69.7	69.9				
AEMI	35.5	33.3	47.4	84.5				
HCCA	31.6	32.8	53.2	83.4				
TVCX	32.1	32.2	54.1	83.4				
GFEX	36.5	39.2	66.2	102.0				
TVCE	31.4	31.2	53.0	75.1				
TVDG	32.1	32.2	53.6	91.8				
TABD	70.0	138.3	255.0	429.4				
TABM	46.3	51.3	92.9	189.8				
TABS	43.8	52.7	71.9	135.1				
Forecasts	7	5	3	1				



Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Sandra, 7–9 November 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	0.7	3.0	3.3	0.0				
OCD5	4.1	9.4	13.7	13.0				
Forecasts	7	5	3	1				
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 Sandra, 7–9 November 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	0.7	3.0	3.3	0.0				
OCD5	4.1	9.4	13.7	13.0				
HWFI	4.1	6.8	6.7	0.0				
HMNI	4.4	8.4	7.3	6.0				
DSHP	1.9	3.6	3.0	7.0				
LGEM	1.9	4.2	4.3	8.0				
ICON	2.6	4.8	4.3	2.0				
IVCN	3.0	4.8	4.3	1.0				
GFSI	2.9	3.6	3.7	4.0				
EMXI	2.6	3.8	4.7	3.0				
HCCA	3.4	6.2	5.0	0.0				
Forecasts	7	5	3	1				

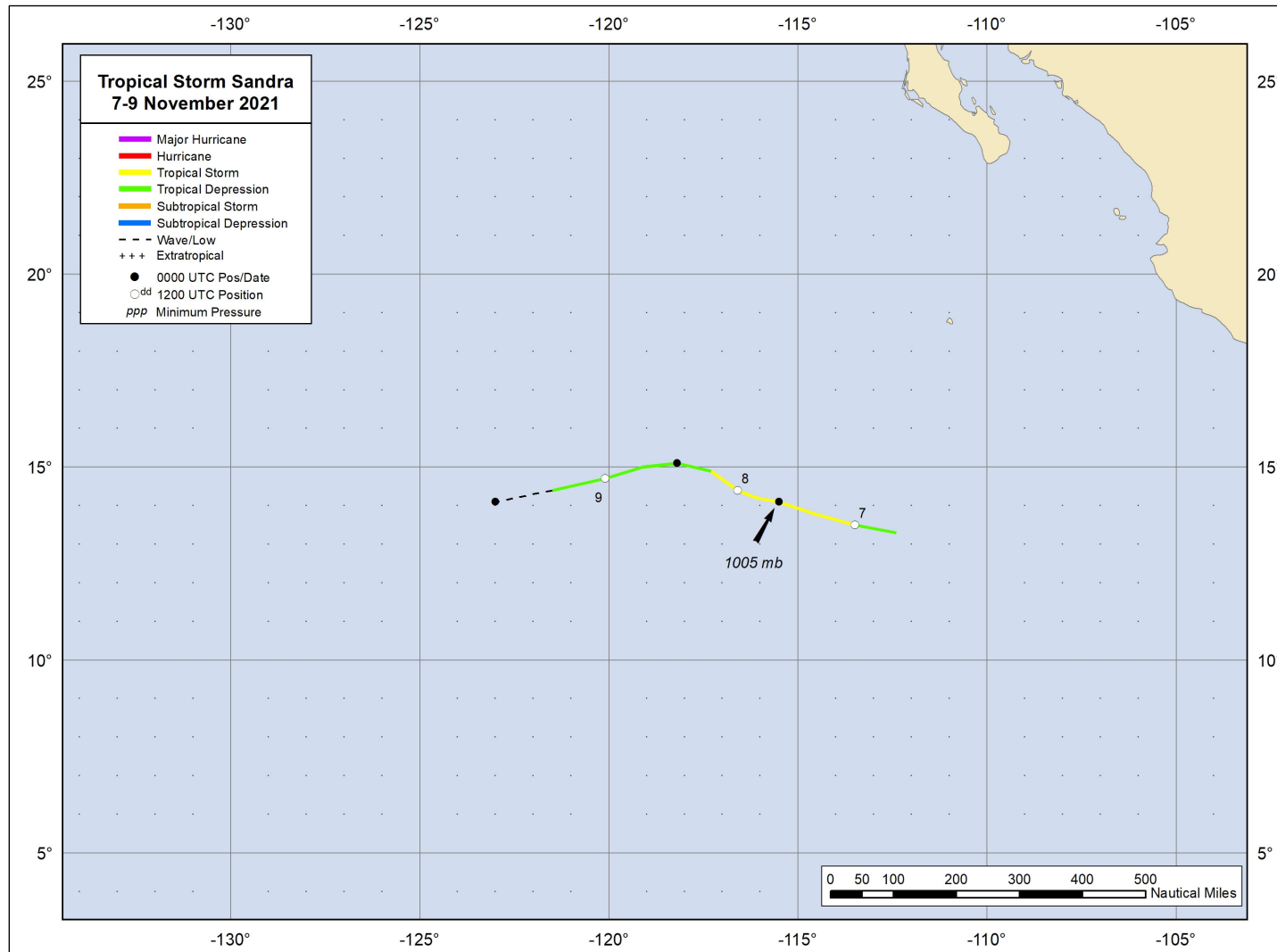


Figure 1. Best track positions for Tropical Storm Sandra, 7–9 November 2021.

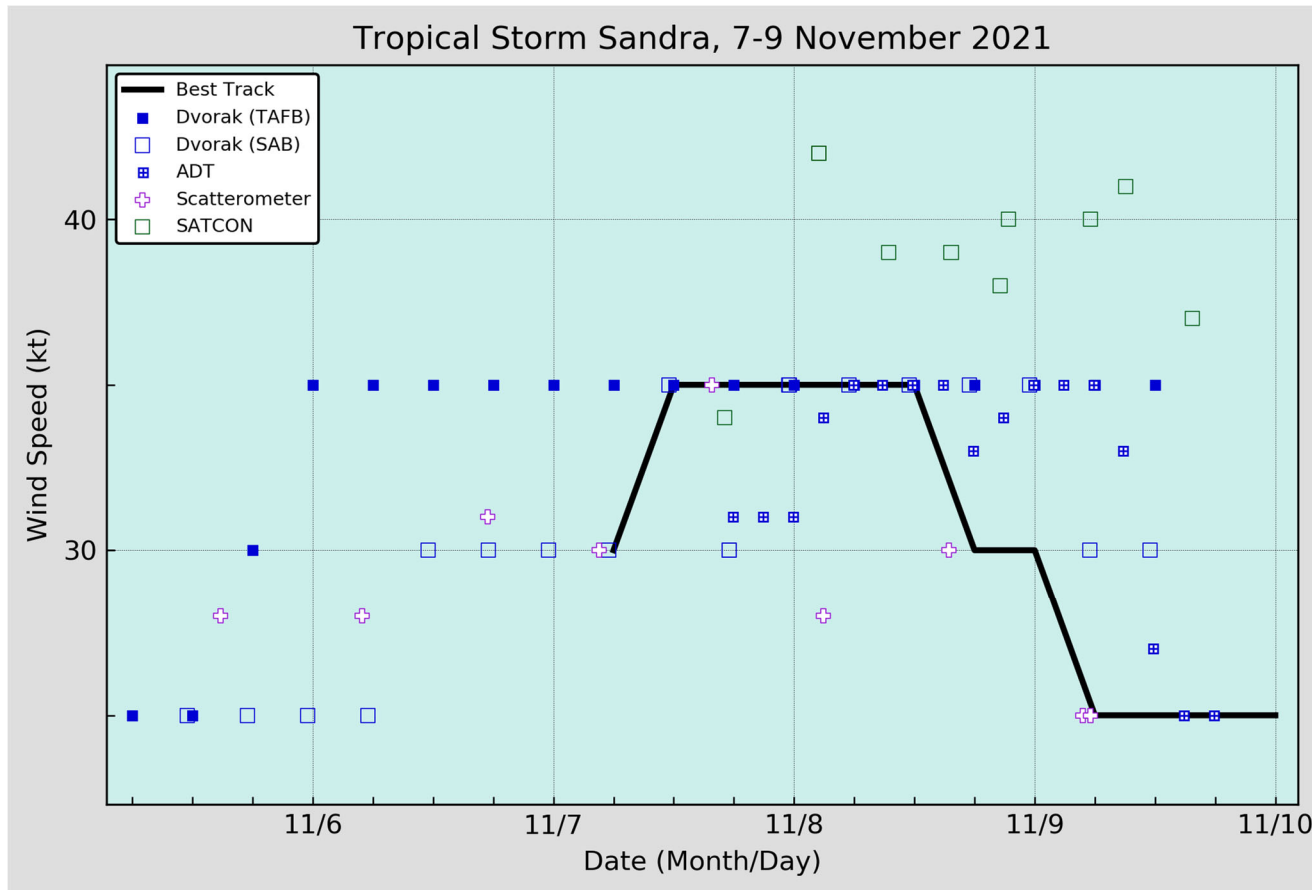


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Sandra, 7–9 November 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

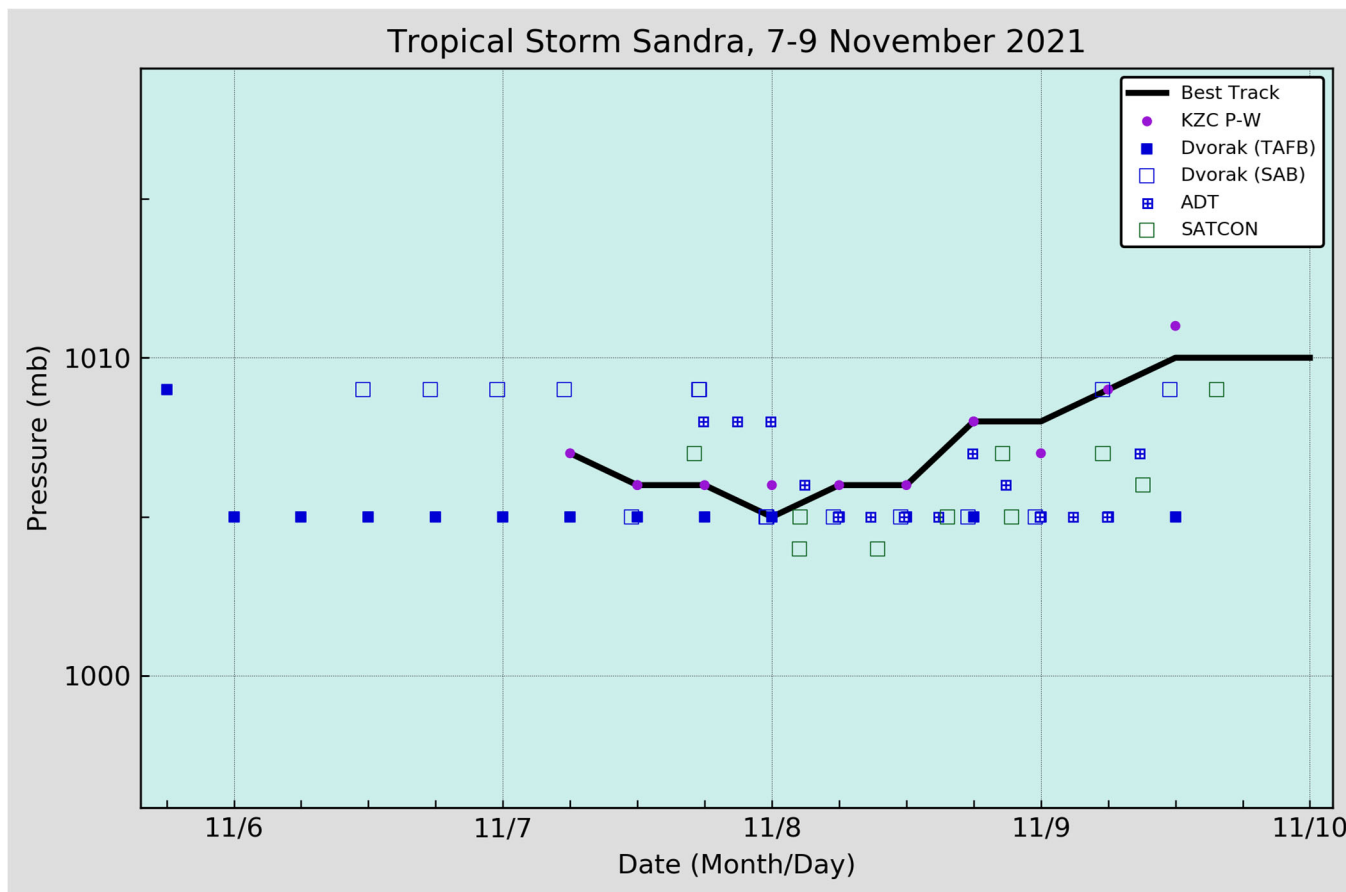


Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Sandra, 7–9 November 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological 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.