NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

TROPICAL STORM LOWELL

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20–25 September 2020

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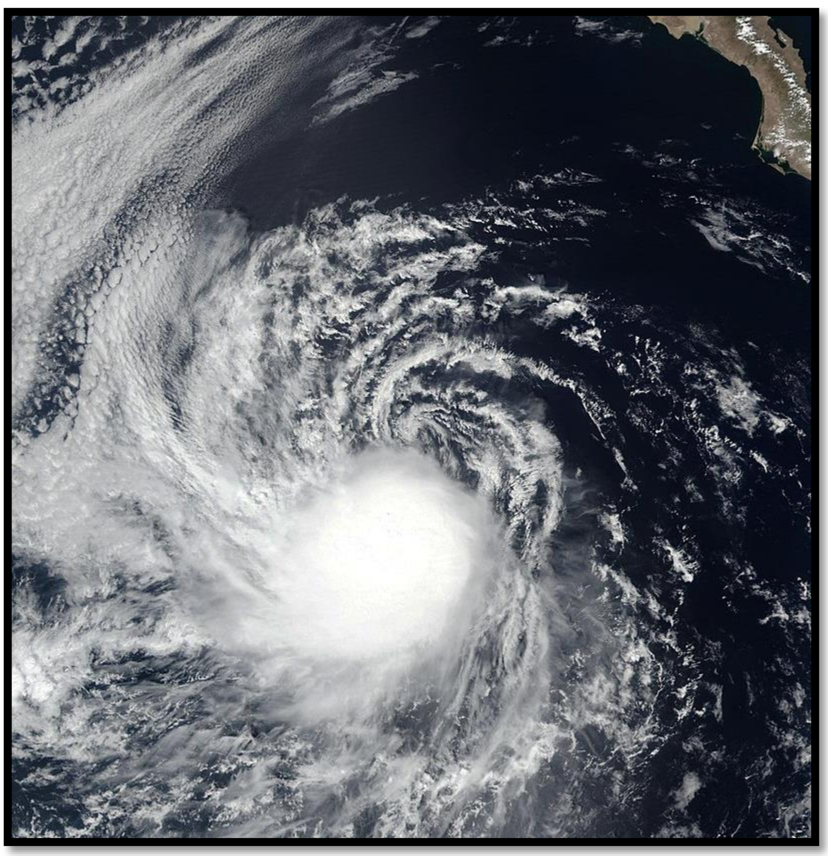

NASA MODIS/AQUA VISIBLE IMAGE OF TROPICAL STORM LOWELL AT 2130 UTC 22 SEPTEMBER 2020

Lowell was a sheared tropical storm that developed off the southwestern coast of Mexico and remained out at sea.

Tropical Storm Lowell

20–25 SEPTEMBER 2020

SYNOPTIC HISTORY

The genesis of Lowell appears to be primarily associated with a trough of low pressure that formed to the south of Atlantic Tropical Storm Beta. Satellite data indicate that a trailing low-level trough developed on the south side of Beta on 18 September, and stretched from the southwestern Gulf of Mexico to the eastern Pacific Ocean. Showers and thunderstorms gradually organized at the base of the trough during the next day or two while it moved westward to the south of Mexico. This area of disturbed weather developed enough organized deep convection and a well-defined center of circulation by 1800 UTC 20 September, marking the formation of a tropical depression when it was located about 500 n mi south-southeast of the southern tip of the Baja California peninsula. 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].

At the time of formation, the tropical cyclone was feeling some effects of northeasterly wind shear with the center located near the northeastern edge of the main area of deep convection. The shear caused the system to remain relatively steady in strength during the first 12–18 h of its lifetime as the depression moved west-northwestward on the south side of a subtropical ridge. Deep convection formed over the center on 21 September when the shear lessened a little, and that led to the cyclone strengthening to Tropical Storm Lowell by 1800 UTC that day, when it was located about 400 n mi south-southwest of the southern tip of the Baja California peninsula. The tropical storm slowly strengthened during the next 36 h while it continued moving west-northwestward within an environment of moderate wind shear and over relatively warm waters. Lowell reached its peak intensity of 45 kt by 0600 UTC 23 September when it was located about 700 n mi south-southwest of the southern tip of the Baja California peninsula. The slow strengthening trend ended on 23 September as the shear again increased, this time from the northwest, and as the storm began its journey over cooler waters. Deep convection became confined to the eastern portion of the circulation by late that day, and the thunderstorms gradually decreased during the next day or two due to a combination of drier air and cooler waters, which caused Lowell to slowly weaken.

Satellite images indicate that deep convection became very limited and well removed to the east of the center on 25 September, and completely dissipated by 1800 UTC that day. As a result, Lowell became a post-tropical remnant low at that time when it was located about 1100 n mi west of the southern tip of the Baja California peninsula. Within the low-level flow, the

[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.

remnant low moved westward during the next few days and opened into a trough of low pressure by 0000 UTC 28 September when it was located about 800 n mi east of the Big Island of Hawaii.

METEOROLOGICAL STATISTICS

Observations in Lowell (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), 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), ASCAT, and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Lowell.

Lowell's estimated peak intensity of 45 kt from 0600 to 1800 UTC 23 September is based on an ASCAT pass from 0443 UTC that day that showed peak winds in the 40–45 kt range and 3.0/45 kt subjective Dvorak satellite classifications from TAFB and SAB during that time period. The estimated minimum pressure of 1001 mb is based on the Knaff-Zehr-Courtney pressure wind relationship.

There were no observations from ships or land stations of winds of tropical storm force associated with Lowell.

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

The genesis of Lowell was not well forecast, as the tropical cyclone formed sooner than anticipated (Table 2). The system from which Lowell developed was introduced in the Tropical Weather Outlook only 42 h prior to genesis with a low (<40%) chance of formation during the next 5 days. The 5-day probabilities were increased to the medium (40–60%) and high (>60%) categories 30 h and 24 h before Lowell formed, respectively. Regarding the 2-day genesis probabilities, a low chance of genesis was shown 24 h, a medium chance 18 h, and a high chance 12 h before the system developed.

A verification of NHC official track forecasts for Lowell is given in Table 3a. Official forecast track errors were a little lower than the mean official errors for the previous 5-yr period from 12 to 48 h, but greater than the long-term mean from 60 to 96 h. There were no verifying forecasts at 120 h. Most of the verifying official forecasts from 60 to 96 h had a south (left) bias, with several of the forecasts predicting that Lowell would move more westward than what occurred. This bias was also present in most of the models, likely due to them showing the mid-level ridge to the north of Lowell being stronger than what was observed. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. Several of the consensus models had lower track errors than NHC from 48 to 96 h. In addition, EGRI and EMXI had low track errors for Lowell from 60 to 96 h.

A verification of NHC official intensity forecasts for Lowell is given in Table 4a. Official forecast intensity errors were lower than the mean official errors for the previous 5-yr period from 12 to 48 h, but above the long-term mean at 72 and 96 h. It should be noted that the climatology and persistence model errors (OCD5) were quite low from 36 h to 96 h, and well below the NHC errors, indicating that the NHC intensity forecasts were not skillful for those time periods. NHC had a high bias at the longer forecast times for Lowell as several of the forecasts anticipated that the cyclone would be near hurricane strength. However, Lowell did not strengthen as much as forecast, possibly because it moved farther north and over cooler waters sooner than anticipated. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. No model consistently beat the official forecasts, but overall LGEM had the lowest errors. Conversely, HWFI and CTCI had very large errors and a high bias for Lowell, as several of the runs from those models showed Lowell becoming a hurricane.

There were no coastal watches and warnings associated with Lowell.

Table 1. Best track for Tropical Storm Lowell, 20–25 September 2020.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
20 / 1800	15.7	108.0	1006	25	tropical depression
21 / 0000	16.0	109.2	1006	25	"
21 / 0600	16.4	110.4	1006	25	"
21 / 1200	16.8	111.6	1004	30	"
21 / 1800	17.2	112.8	1003	35	tropical storm
22 / 0000	17.5	114.0	1002	40	"
22 / 0600	17.9	115.1	1002	40	"
22 / 1200	18.2	116.1	1002	40	"
22 / 1800	18.7	117.1	1002	40	"
23 / 0000	19.1	118.2	1002	40	"
23 / 0600	19.6	119.3	1001	45	"
23 / 1200	20.1	120.4	1001	45	"
23 / 1800	20.5	121.5	1001	45	"
24 / 0000	20.9	122.5	1002	40	"
24 / 0600	21.3	123.5	1003	40	"
24 / 1200	21.6	124.4	1003	40	"
24 / 1800	21.7	125.3	1003	40	"
25 / 0000	21.7	126.3	1004	40	"
25 / 0600	21.7	127.4	1005	40	"
25 / 1200	21.6	128.6	1005	35	"
25 / 1800	21.5	129.8	1006	30	low
26 / 0000	21.5	131.2	1006	30	"
26 / 0600	21.6	132.6	1006	30	"
26 / 1200	21.6	133.9	1006	30	"
26 / 1800	21.5	135.2	1006	30	"
27 / 0000	21.3	136.5	1007	30	"
27 / 0600	21.1	137.9	1007	30	"
27 / 1200	21.1	139.4	1007	25	"
27 / 1800	21.0	140.8	1008	25	"
28 / 0000					dissipated
23 / 0600	19.6	119.3	1001	45	maximum wind 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%)	24	42
Medium (40%-60%)	18	30
High (>60%)	12	24

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Lowell. 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	**18.8**	**31.0**	**41.6**	**54.0**	70.2	95.2	132.7	
OCD5	26.7	50.4	75.6	111.0	144.3	188.8	323.6	
Forecasts	18	16	14	12	10	8	4	
OFCL (2015-19)	21.8	34.0	44.9	55.3	66.2	77.1	99.1	123.2
OCD5 (2015-19)	34.3	69.9	108.7	146.8	181.4	216.0	268.7	328.0

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Lowell. 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	18.3	26.1	34.3	57.2	86.3	105.3	134.8	
OCD5	21.2	43.8	65.5	97.5	102.5	130.0	229.2	
GFSI	24.0	34.4	49.8	82.3	115.3	148.2	200.7	
HMNI	**17.7**	28.3	40.7	71.4	95.8	121.9	210.8	
HWFI	24.0	38.3	63.1	97.8	125.6	150.2	200.0	
EGRI	**17.5**	29.2	44.6	62.3	**78.0**	**85.3**	**86.6**	
EMXI	21.0	28.8	36.7	**40.8**	**51.1**	**56.7**	**45.9**	
CMCI	21.1	31.3	47.6	79.1	94.9	115.8	**122.1**	
NVGI	21.9	34.0	50.8	82.9	118.1	152.3	188.9	
CTCI	21.8	31.7	45.5	61.9	**76.5**	**103.6**	139.6	
AEMI	23.7	33.0	43.4	68.0	90.5	108.8	162.6	
TVCA	18.7	**24.9**	**34.0**	**55.4**	**81.7**	**98.0**	**124.3**	
HCCA	18.5	26.8	36.6	**56.5**	**83.0**	**102.7**	**129.3**	
TVDG	**17.9**	**24.0**	**33.8**	**54.8**	**79.1**	**97.3**	**124.3**	
GFEX	21.7	27.1	34.6	**50.2**	**79.0**	**95.9**	**124.3**	
TVCX	18.7	**24.6**	**32.6**	**52.1**	**76.9**	**92.6**	**119.2**	
TABS	31.3	60.4	71.0	65.6	**64.2**	**56.1**	156.6	
TABM	20.3	31.9	**30.5**	**33.8**	**61.9**	**95.1**	195.7	
TABD	18.4	37.7	51.1	83.6	115.5	165.5	248.4	
Forecasts	12	11	9	7	5	5	1	

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Lowell. 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**	**4.4**	**5.0**	**10.4**	14.5	18.8	18.8	
OCD5	4.4	5.6	4.0	4.4	4.3	5.8	6.5	
Forecasts	18	16	14	12	10	8	4	0
OFCL (2015-19)	6.0	9.9	12.1	13.5	14.5	15.4	15.6	16.4
OCD5 (2015-19)	7.8	13.0	16.6	18.9	20.2	21.4	22.6	22.4

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Lowell. 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	3.2	4.2	5.5	11.7	16.4	18.6	18.3	
OCD5	4.0	5.2	**3.5**	**2.9**	**5.1**	**6.0**	**7.7**	
HWFI	3.9	**3.5**	8.8	15.3	20.3	22.0	34.0	
HMNI	4.7	6.2	8.4	**9.1**	**10.0**	**13.0**	**15.0**	
CTCI	3.3	**3.5**	7.5	15.7	20.3	23.0	30.3	
DSHP	3.6	**3.9**	**1.9**	**4.4**	**10.6**	**15.4**	25.7	
LGEM	4.1	5.5	**4.7**	**5.3**	**6.7**	**5.4**	**4.3**	
HCCA	4.0	5.2	8.5	15.7	20.3	20.7	23.0	
IVCN	3.4	**3.1**	**4.5**	**8.7**	**11.9**	**14.6**	20.7	
GFSI	**2.9**	5.8	8.0	**7.0**	**9.4**	**12.7**	25.0	
EMXI	**3.1**	6.1	6.7	**8.3**	**9.6**	**8.1**	**9.3**	
Forecasts	14	13	11	9	7	7	3	

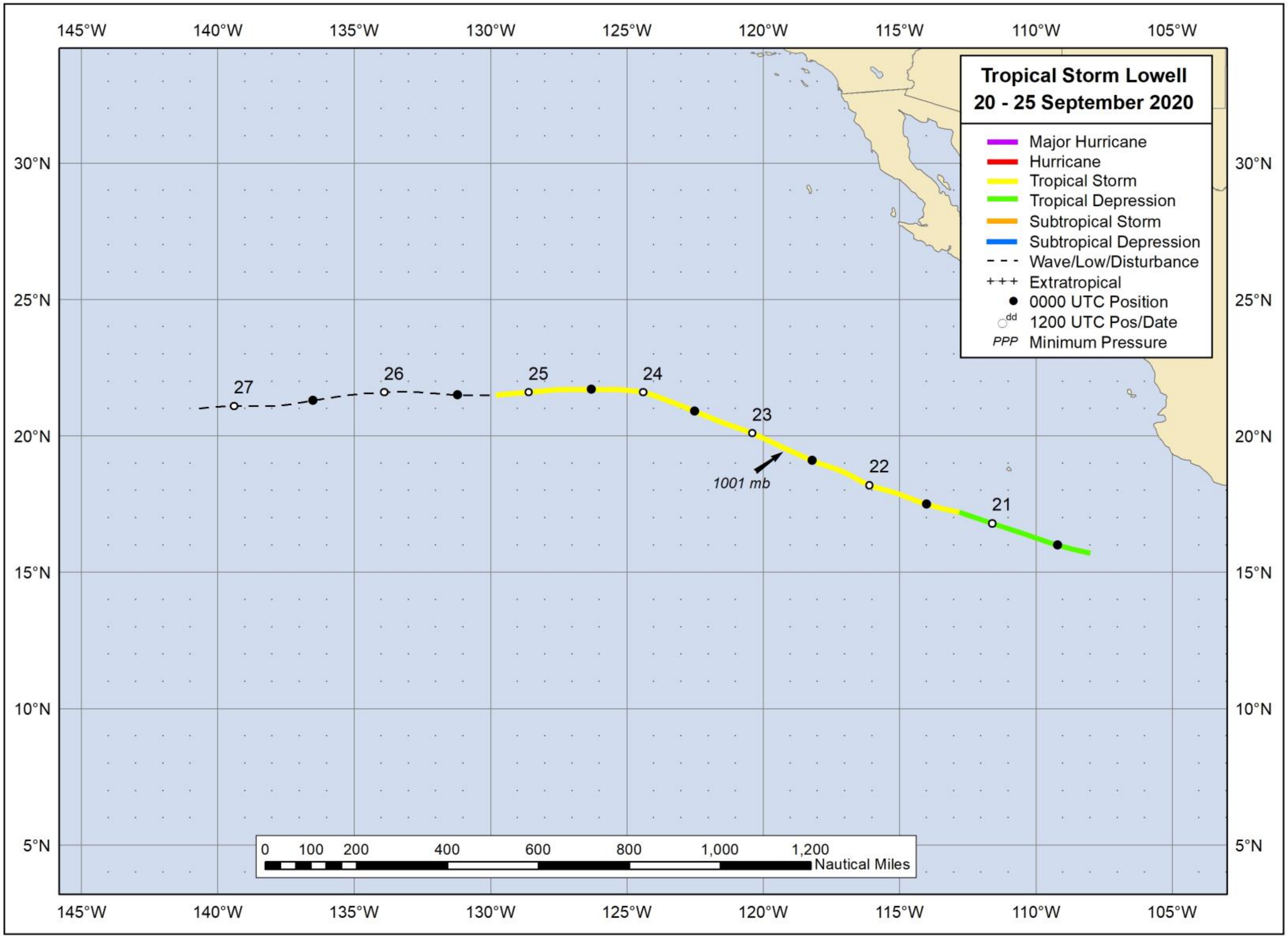

Figure 1. Best track positions for Tropical Storm Lowell, 20–25 September 2020.

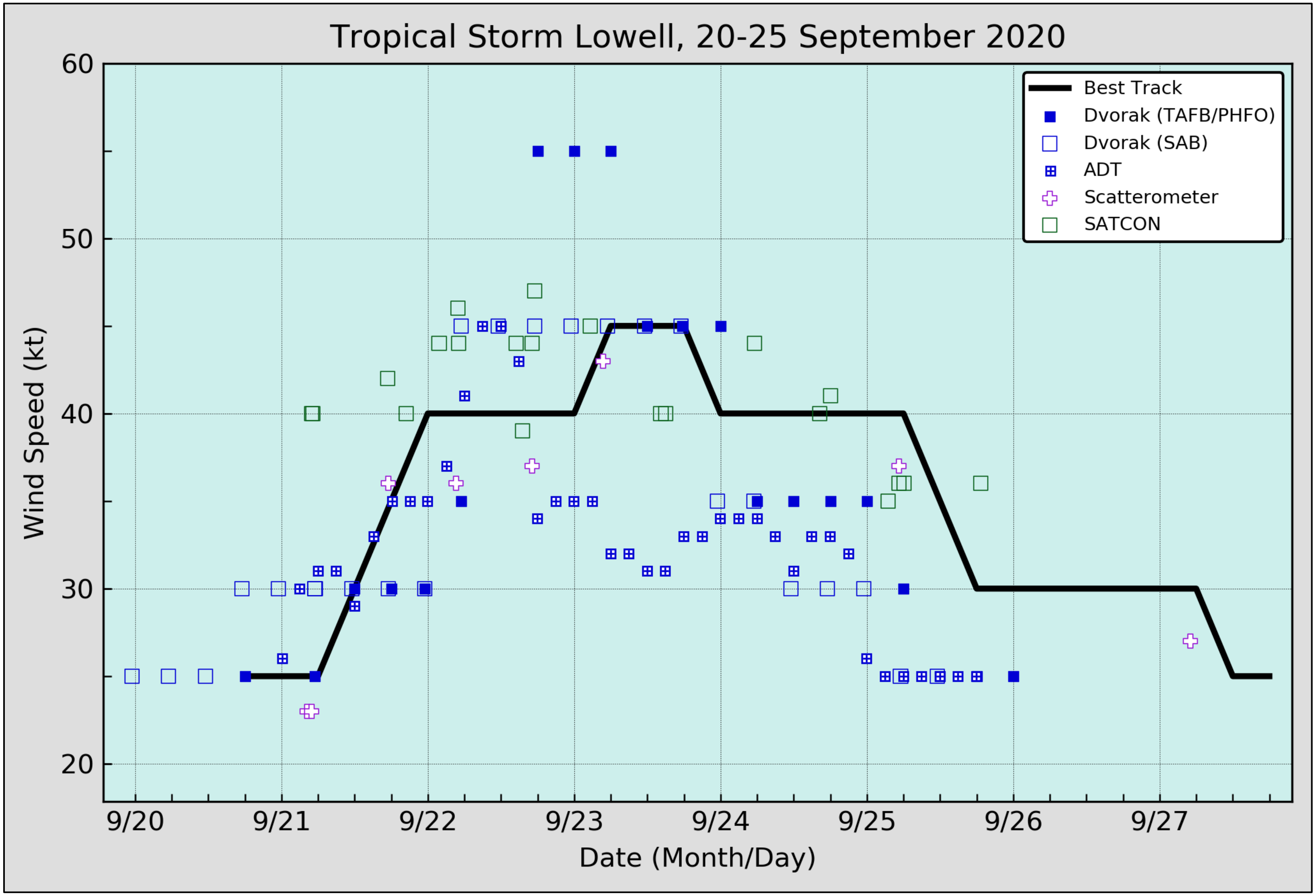

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Lowell, 20–25 September 2020. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Advanced Dvorak Technique estimates represent the 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.

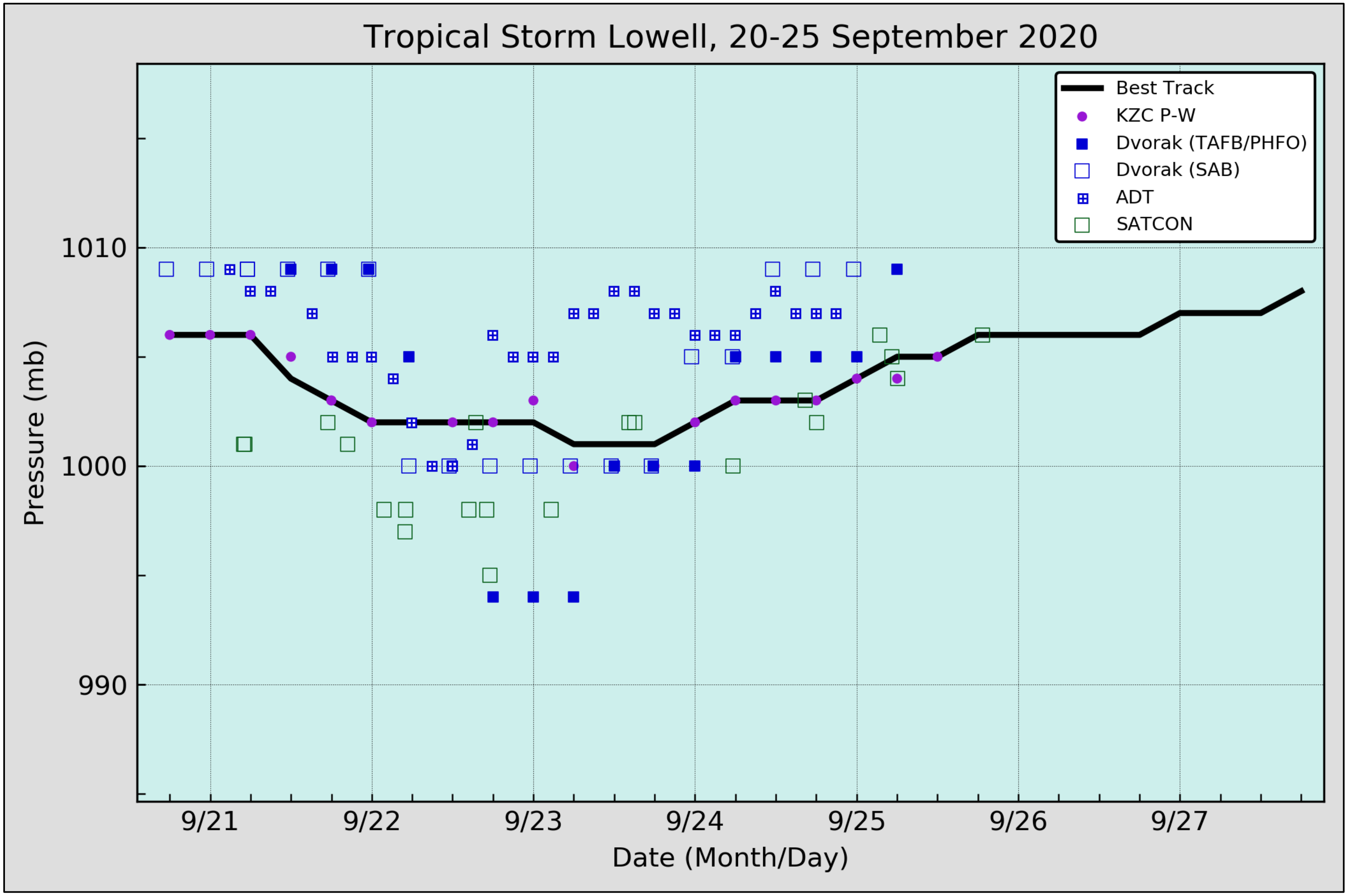

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Lowell, 20–25 September 2020. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. 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.