NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE SERGIO

(EP212018)

29 September–12 October 2018

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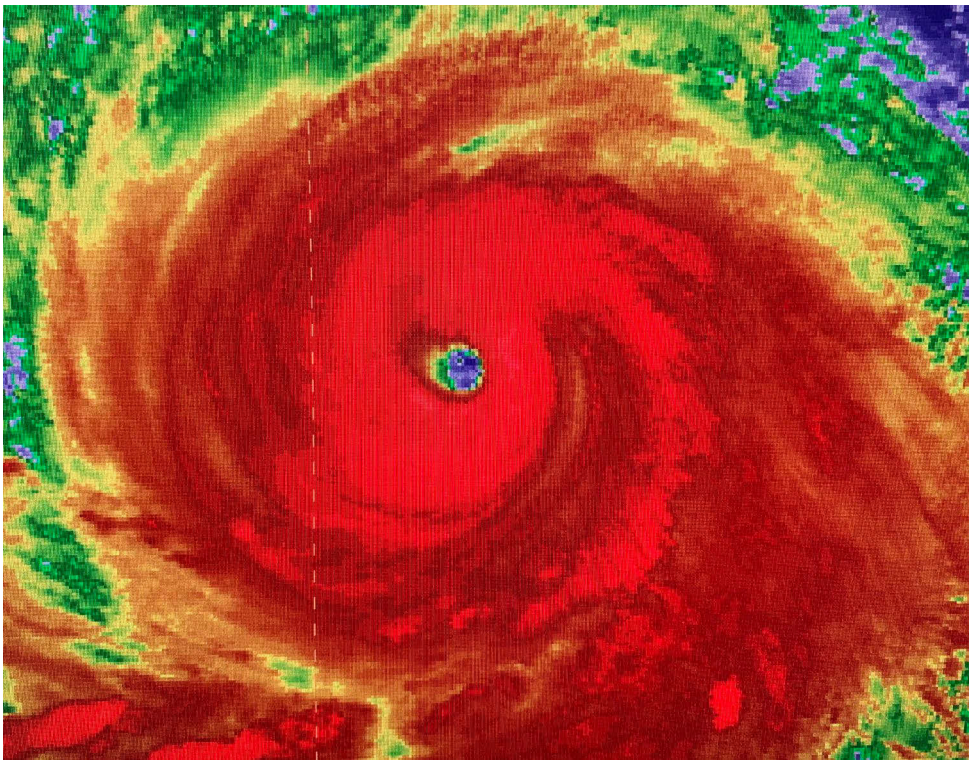

GOES-16 INFRARED IMAGE OF SERGIO NEAR PEAK INTENSITY AT 0600 UTC 4 OCTOBER 2018.

Sergio was a long-lasting tropical cyclone that took a sinuous track over the eastern Pacific Ocean. It peaked as a category 4 hurricane (on the Saffir-Simpson Hurricane Wind Scale) before weakening over cooler waters and turning back toward Mexico. While it eventually made landfall in Baja California Sur as a low-end tropical storm, the overall impacts were not severe.

Hurricane Sergio

29 SEPTEMBER–12 OCTOBER 2018

SYNOPTIC HISTORY

Sergio could have originated from a tropical wave that left the coast of west Africa on 13 September. This feature lost definition over the tropical Atlantic Ocean during the next few days, with little signature in either the wind or convective fields. While extrapolation suggests the wave could have led to Sergio's formation, the degradation in the signal makes it impossible to conclusively link the wave to the first clear precursor system that was noted over northwestern South America on 24 September. The disturbance produced increased convection as it passed over Central America during the next two days. The thunderstorm pattern consolidated on 27 September over the eastern Pacific waters, although NOAA Hurricane Hunter aircraft data showed only a weak surface trough. Persistent convection started the next day near the trough, which led to an increase in winds and low-level organization. However, while the NOAA aircraft showed that tropical-storm-force winds were now present, the large disturbance lacked a well-defined center. A well-defined low formed on the next day by 1200 UTC 29 September, marking the formation of a tropical storm about 335 n mi south of Zihuatanejo, Mexico. The "best track" chart of Sergio'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].

A mid-level ridge to the north of Sergio caused the tropical storm to move westward for the day after genesis. The ridge strengthened during the first two days of October, resulting in Sergio turning toward the west-southwest. Although the storm was located within a favorable low-shear, warm-water environment, the cyclone only gradually intensified during that time, potentially due to its large radius of maximum winds and some dry mid-level air which prevented inner-core development. Satellite images indicate that Sergio became a hurricane early on 2 October, and microwave data showed that an eyewall had closed off. This structural change preceded a 24-h period of rapid intensification within which the hurricane attained category 3 status, followed by the cyclone's peak wind speed leveling off on 3 October due to an eyewall replacement cycle (ERC). Sergio also turned toward the west and northwest during 3 and 4 October as a mid-latitude trough weakened the subtropical ridge. After completing the ERC, Sergio resumed intensification, reaching its peak intensity of 120 kt near 0600 UTC 4 October about 715 n mi southwest of Cabo San Lucas, Mexico. Another ERC led to the hurricane weakening back to category 3 status on 5 October, but the cyclone then re-strengthened slightly later that day as the cycle completed and a new, larger 25 to 30 n mi-wide eye formed. During this time, Sergio turned westward and west-southwestward again as it came under the influence of a distant mid-latitude ridge.

[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.

Over the next few days, the hurricane slowed down as the ridge moved away and Sergio gradually turned toward the northeast due to a new mid-latitude trough over the eastern Pacific Ocean. Within a generally light-shear environment, the cyclone underwent yet another ERC and formed a rather large eye on 8 October. Sergio had many annular characteristics while it only slowly lost strength over the next couple of days due to cooling sea-surface temperatures. The cyclone was gradually accelerated toward the northeast and east-northeast by the aforementioned trough from 10 to 11 October and maintained an intensity of about 55 kt in the low shear but marginal SST environment. As the storm approached Baja California Sur, the cyclone lost most of its deep convection due to colder waters, and Sergio weakened more quickly on 12 October. The center of the broad circulation made landfall near Los Castros on the western side of Baja California Sur near 1200 UTC that day with 45-kt sustained winds, then moved rapidly across the Gulf of California. Six hours later, the center of Sergio came ashore in mainland Mexico near Reserva Especial de la Biosfera Cajón del Diablo, a Sonoran state park, about 20 n mi west-northwest of Guaymas, with an intensity of 30 kt. The depression quickly dissipated over the mountains over Mexico just a few hours after its final landfall.

METEOROLOGICAL STATISTICS

Observations in Sergio (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB), the Satellite Analysis Branch (SAB), and the objective Advanced Dvorak Technique (ADT) estimates and Satellite Consensus (SATCON) estimates from CIMSS at the University of Wisconsin. Observations also include flight-level and stepped frequency microwave radiometer (SFMR) data from two research flights of a NOAA P-3 Hurricane Hunter aircraft. 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 estimated peak intensity of 120 kt is based on a blend of higher subjective Dvorak estimates from TAFB/SAB and lower values from SATCON.

There were few land-based surface observations from Sergio. An elevated station (40 m) at Roca Alijos, a group of rocky islets located offshore a couple of hundred n mi southwest of Baja California Sur, reported 15-minute sustained winds of 60 kt at 0515 UTC 12 October with a peak gust to 78 kt. A standard wind reduction to an elevation of 10 m suggests maximum winds of Sergio near 55 kt at that time. Two stations reported tropical-storm-force wind gusts at an unknown time on 12 October: Guaymas (45 kt) and Santa Rosalia (52 kt). It should be noted that the landfall intensities over Mexico are uncertain because very little data were available during that time near the landfall location.

Sergio was the fourth longest-lasting tropical storm in the eastern Pacific since records began in 1949, with 13.25 named storm days. Sergio was also the longest-lasting tropical storm in that basin since 1992.

CASUALTY AND DAMAGE STATISTICS

There were no deaths or injuries reported in association with Sergio. Very heavy rains and gusty winds caused flooding and power outages in Baja California Sur and Sonora, but only minimal damage was reported. No monetary damage estimates are available. Increased moisture from the remnants of Sergio indirectly led to heavy rainfall and flooding in portions of Arizona and Texas during the week following landfall in Mexico.

FORECAST AND WARNING CRITIQUE

The genesis forecasts for Sergio (Table 2) were good for the 5-day predictions and quite good for the 2-day forecasts. The system was introduced into the Tropical Weather Outlook 84 h before genesis occurred with a low (< 40% chance) of genesis within 5 days, and the chances reached the high (40–60%) category 48 h before formation. For the 2-day predictions, the system was given a low chance 66 h before it formed, with a high probability 36 h before genesis. The incipient disturbance was fairly large, which probably contributed to skillful model and NHC genesis forecasts, with long lead-times especially for the 2-day product.

A verification of NHC official track forecasts for Sergio is given in Table 3a. Official forecast track errors (OFCL) were lower than the 5-yr mean official errors at all time periods, which is especially notable since Sergio had an unusual track, resulting in high OCD5 (climatology) errors. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. The official forecast was consistently better than most of the model guidance, with only the consensus aids and the ECMWF (EMXI) model forecasts having lower errors. The ECMWF performance is especially noteworthy at long range since it beat all of the other models by 20% or more. The UKMET (EGRI) model had particularly high errors for Sergio, and it was even beaten by the typically lower-skill NAVGEM (NVGI) and Canadian (CMCI) models beyond 48 h.

A verification of NHC official intensity forecasts for Sergio is given in Table 4a. Official intensity forecast errors were below the mean official errors for the previous 5-yr period at all forecast times. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. The NHC forecast verified very well against the model guidance, with no model consistently beating the official prediction. Only the consensus aids IVCN and IVDR (the double-weighted dynamical model consensus) were more skillful than OFCL from 36/48 h to 72 h, and the NOAA-corrected consensus (HCCA) had the best errors at 72 and 96 h.

Watches and warnings required for Sergio are listed in Table 5.

Table 1. Best track for Hurricane Sergio, 29 September–12 October 2018.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
29 / 1200	12.0	101.3	1005	35	tropical storm
29 / 1800	12.0	102.2	1005	35	"
30 / 0000	12.0	103.1	1003	40	"
30 / 0600	11.9	103.9	1001	45	"
30 / 1200	11.7	104.8	999	50	"
30 / 1800	11.6	105.8	997	55	"
01 / 0000	11.5	106.9	997	55	"
01 / 0600	11.4	108.0	997	55	"
01 / 1200	11.3	109.1	994	60	"
01 / 1800	11.1	110.3	994	60	"
02 / 0000	10.9	111.5	991	65	hurricane
02 / 0600	10.7	112.5	985	75	"
02 / 1200	10.8	113.5	973	90	"
02 / 1800	11.1	114.5	960	105	"
03 / 0000	11.5	115.4	960	105	"
03 / 0600	12.0	116.2	959	105	"
03 / 1200	12.5	116.9	959	105	"
03 / 1800	12.9	117.5	951	110	"
04 / 0000	13.5	118.0	947	115	"
04 / 0600	14.1	118.5	942	120	"
04 / 1200	14.7	119.0	942	120	"
04 / 1800	15.3	119.6	942	120	"
05 / 0000	15.7	120.2	951	110	"
05 / 0600	15.9	120.8	958	100	"
05 / 1200	15.9	121.4	958	100	"
05 / 1800	15.7	122.0	955	105	"
06 / 0000	15.4	122.5	950	110	"
06 / 0600	15.0	123.1	950	110	"

06 / 1200	14.8	123.7	950	110	"
06 / 1800	14.7	124.4	951	110	"
07 / 0000	14.6	125.1	955	105	"
07 / 0600	14.5	125.8	959	100	"
07 / 1200	14.5	126.5	966	90	"
07 / 1800	14.5	127.2	970	85	"
08 / 0000	14.7	127.8	974	80	"
08 / 0600	14.9	128.2	978	75	"
08 / 1200	15.2	128.5	978	75	"
08 / 1800	15.5	128.6	978	75	"
09 / 0000	15.8	128.5	981	70	"
09 / 0600	16.1	128.2	981	70	"
09 / 1200	16.4	127.7	985	65	"
09 / 1800	16.7	127.0	988	60	tropical storm
10 / 0000	17.0	126.2	989	60	"
10 / 0600	17.4	125.2	992	55	"
10 / 1200	17.9	124.3	992	55	"
10 / 1800	18.6	123.3	992	55	"
11 / 0000	19.4	122.2	992	55	"
11 / 0600	20.4	120.9	992	55	"
11 / 1200	21.5	119.5	992	55	"
11 / 1800	22.8	117.9	992	55	"
12 / 0000	24.1	116.3	992	55	"
12 / 0600	25.3	114.7	992	55	"
12 / 1200	26.6	113.0	994	45	"
12 / 1800	28.1	111.2	998	30	tropical depression
13 / 0000	-	-	-	-	dissipated
04 / 0600	14.1	118.5	942	120	minimum pressure and maximum winds
12 / 1200	26.6	113.0	994	45	landfall on Baja California Sur near Los Castros

12 / 1800	28.1	111.2	998	30	landfall on mainland Mexico 20 n mi WNW of Guaymas

Table 2. Number of hours in advance of the formation of Sergio 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	84
Medium (40%-60%)	48	66
High (>60%)	36	48

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Sergio. 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	72	96	120
OFCL	**16.6**	**26.6**	**35.5**	**47.9**	**76.0**	**107.8**	**146.2**
OCD5	37.2	93.0	165.8	245.1	398.8	485.9	529.0
Forecasts	52	50	48	46	42	38	34
OFCL (2013-17)	21.8	33.2	43.0	53.9	80.7	111.1	150.5
OCD5 (2013-17)	34.9	70.7	109.1	146.1	213.8	269.0	339.7

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Sergio. 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	72	96	120
OFCL	15.9	25.7	34.7	47.4	74.2	103.1	146.3
OCD5	35.0	89.3	160.9	236.4	374.8	511.1	588.0
GFSI	20.6	31.1	41.4	53.6	87.1	131.0	191.5
EMXI	**13.4**	**18.2**	**27.2**	**38.3**	**56.2**	**68.4**	**101.4**
EGRI	17.4	29.8	43.6	64.1	108.4	157.0	223.7
HWFI	21.4	33.8	46.0	57.5	89.3	135.6	169.0
HMNI	25.4	36.8	46.8	53.8	**72.9**	115.3	170.5
CTCI	21.0	29.6	40.5	52.2	75.9	103.9	147.6
NVGI	23.0	34.8	44.9	59.0	103.2	148.8	204.7
CMCI	23.6	45.3	65.0	81.9	100.7	121.4	172.2
AEMI	19.8	30.3	42.5	55.4	91.0	129.5	182.0
TVCN	**15.6**	**23.0**	**32.9**	**45.0**	**70.9**	**102.6**	147.7
TVCX	**14.8**	**20.7**	**29.9**	**42.1**	**64.6**	**92.4**	**135.2**
TVCE	16.6	**23.2**	**32.3**	**43.4**	**66.9**	**96.3**	**143.3**
HCCA	**14.7**	**19.8**	**26.1**	**37.9**	**64.8**	**94.1**	**138.9**
FSSE	16.7	**23.0**	**31.5**	**45.3**	**74.0**	113.5	169.0
TABD	28.5	62.0	91.2	108.1	134.5	163.6	226.5
TABM	31.3	60.2	69.0	66.2	103.8	133.7	207.2
TABS	42.2	77.8	86.1	82.1	95.7	134.6	184.2
Forecasts	41	39	37	35	31	30	27

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Sergio. 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	72	96	120
OFCL	**5.7**	**9.0**	**10.5**	**10.7**	**9.5**	**9.7**	**10.4**
OCD5	6.0	10.3	12.3	13.0	18.4	21.1	22.8
Forecasts	52	50	48	46	42	38	34
OFCL (2013-17)	5.8	9.6	11.8	13.2	15.1	15.1	14.6
OCD5 (2013-17)	7.6	12.4	15.6	17.7	19.8	20.8	19.6

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Sergio. 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	72	96	120
OFCL	5.7	9.0	10.6	10.8	9.6	9.7	10.0
OCD5	5.9	10.3	12.4	13.2	18.0	20.5	21.6
GFSI	10.3	15.3	17.9	17.2	19.7	18.9	17.4
EMXI	7.1	11.8	15.7	18.2	19.1	17.8	18.6
DSHP	6.5	11.5	14.9	14.7	11.7	13.3	12.9
LGEM	6.3	11.0	14.6	15.7	13.8	13.9	13.3
HWFI	6.8	10.6	11.7	12.6	11.2	12.7	13.3
HMNI	7.6	12.4	14.4	15.8	18.1	17.7	16.4
IVCN	5.9	9.4	10.6	**10.3**	**9.0**	10.5	11.2
IVDR	6.1	9.4	**10.1**	**9.7**	**9.2**	10.7	11.5
HCCA	6.2	9.8	11.6	11.1	**7.0**	**8.1**	10.3
FSSE	6.3	9.9	11.1	10.9	10.4	12.1	13.9
Forecasts	51	49	47	45	41	37	33

Table 5. Watch and warning summary for Sergio, 29 September–12 October 2018.

Date/Time (UTC)	Action	Location
10 / 0900	Tropical Storm Watch issued	Punta Eugenia to Cabo San Lazaro and Bahia San Juan Bautista to San Evaristo
11 / 0300	Tropical Storm Warning issued	Punta Eugenia to Cabo San Lazaro
11 / 1500	Tropical Storm Warning issued	Bahia San Juan Bautista to Mulege
11 / 1500	Tropical Storm Watch discontinued	South of Mulege to San Evaristo
12 / 1800	Tropical Storm Warning discontinued	All

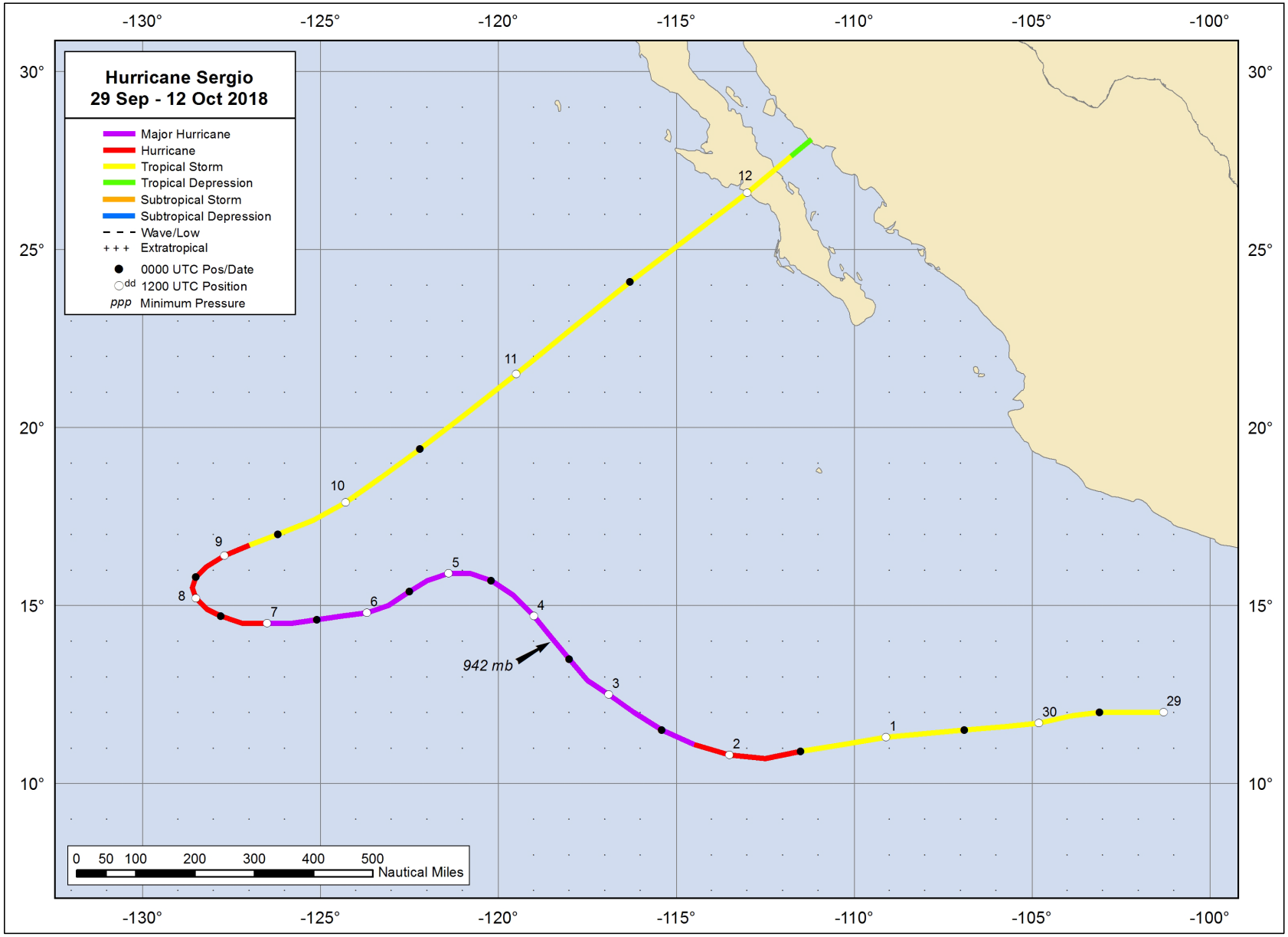

Figure 1. Best track positions for Hurricane Sergio, 29 September–12 October 2018.

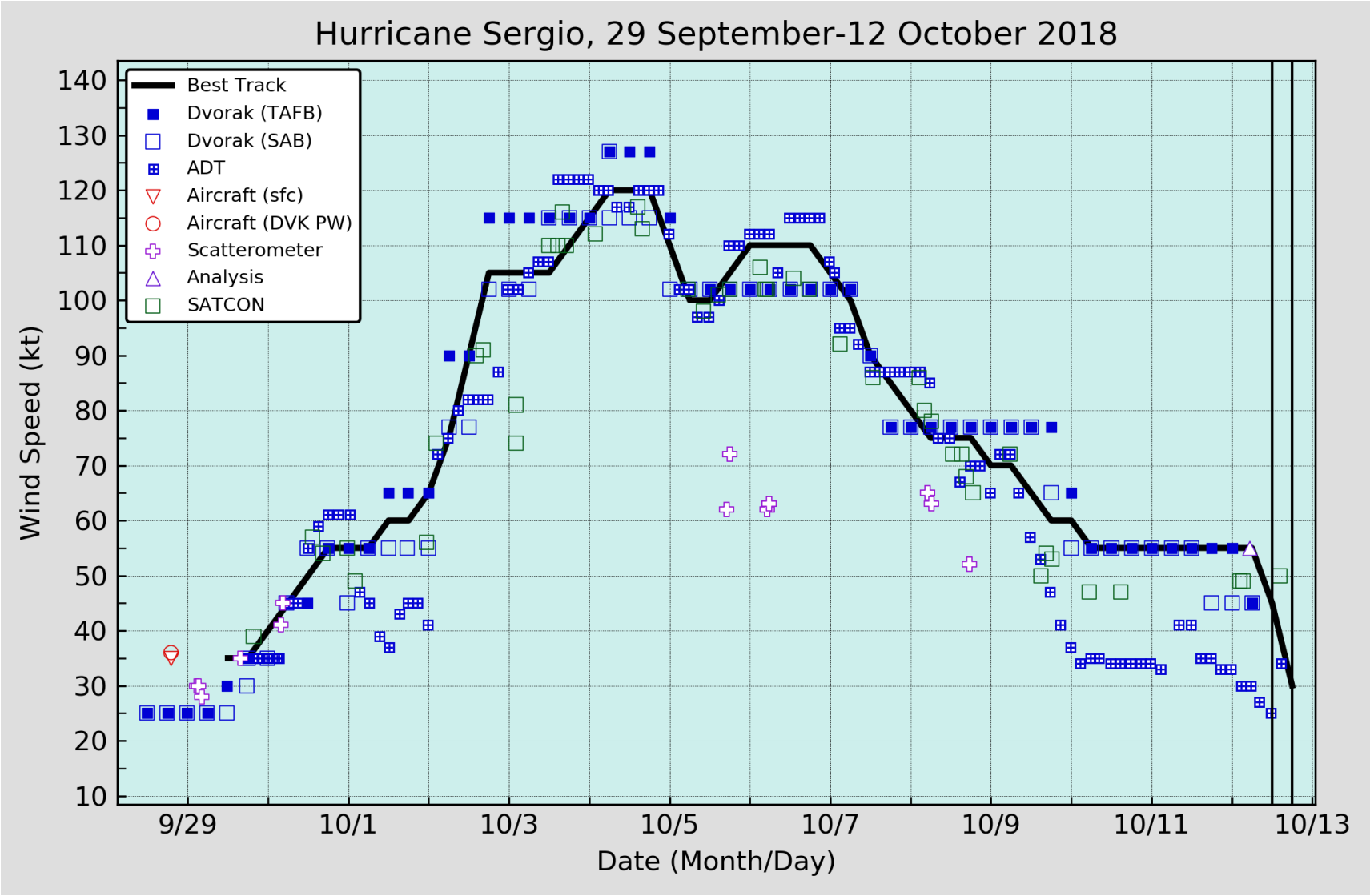

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Sergio, 29 September–12 October 2018. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are the satellite consensus estimates from the Cooperative Institute for Meteorological Satellite Studies. Solid vertical lines correspond to landfalls.

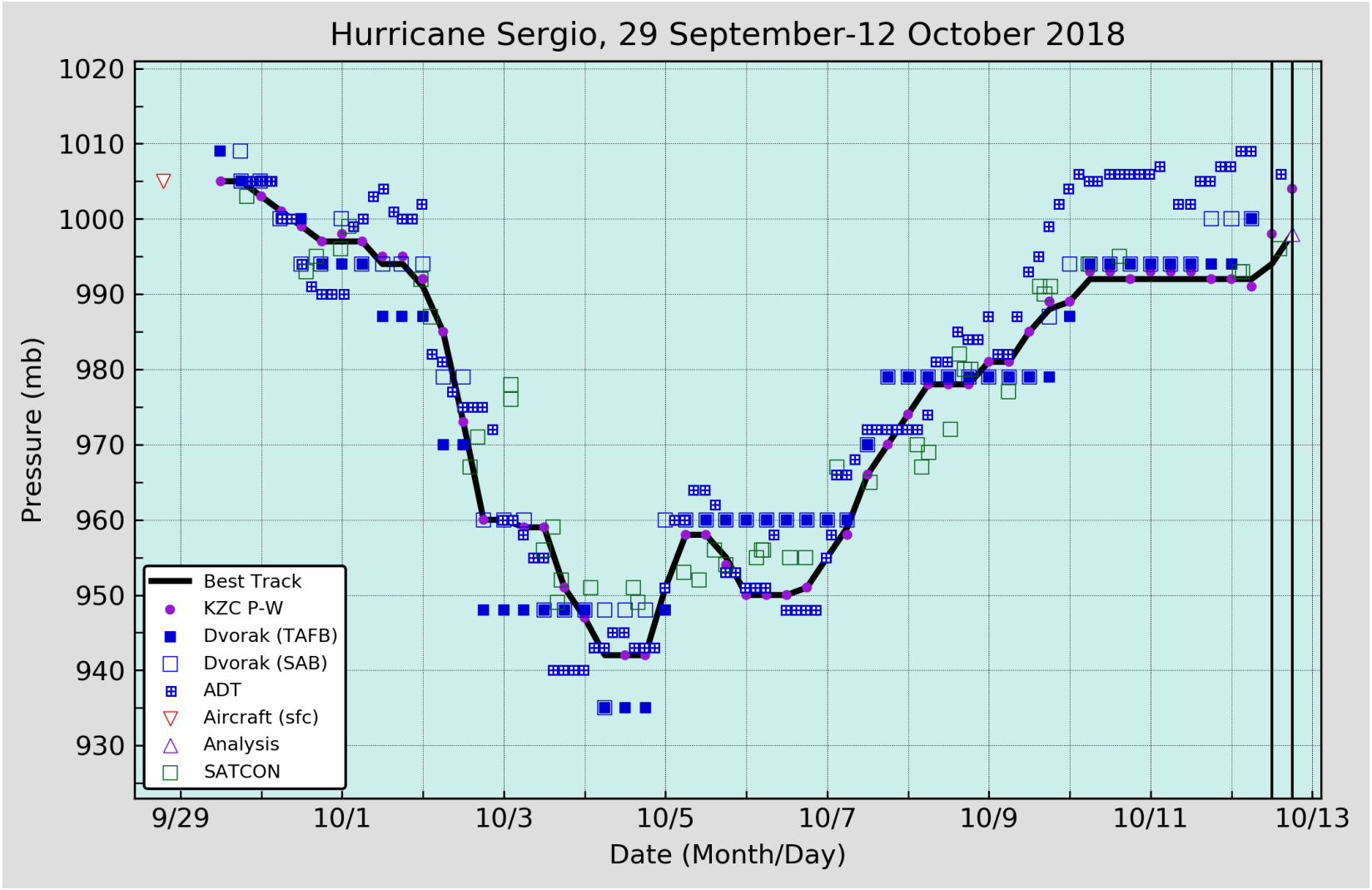

Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Sergio, 29 September–12 October 2018. Advanced Dvorak Technique estimates represent the pressure from the Current Intensity at the nominal observation time. SATCON pressures estimates are the satellite consensus estimates from the Cooperative Institute for Meteorological Satellite Studies. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Solid vertical lines correspond to landfalls.