Tropical Cyclone Report
Tropical Storm Sean
(AL192011)
8-11 November 2011

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Sean was a tropical storm that formed between the Bahamas and Bermuda. The cyclone produced a brief period of tropical-storm-force winds in Bermuda as it moved nearby.

a.   Synoptic History

On 3 November, a low pressure system formed along a frontal zone over the central United States and moved off the U.S. east coast the next day. Earlier, this front had caused heavy snow in Colorado. The extratropical low became nearly stationary between Bermuda and the Bahamas during 6-7 November, after it separated from an eastward-moving mid-latitude frontal trough. Cloudiness and showers gradually increased around the low while a surface circulation became well defined by 1800 UTC 6 November, with a large field of tropical-storm-force winds to the east of the center. Over the next 36 h, both the distribution of the wind field and convection became more symmetric, and it is estimated that a subtropical storm formed at 0600 UTC 8 November about 385 n mi southwest of Bermuda. At this time the surface center was co-located with an upper-level low, hence the subtropical classification. 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].

Sean moved erratically and quickly made a transition into a tropical storm by 1800 UTC later that day when the cyclone separated from the upper-level low, the convection became concentrated near the center, and the system developed an upper-level outflow.   Moving over relatively warm sea surface temperatures, Sean gradually intensified within an environment of light to moderate vertical wind shear. A weak middle-level ridge of high pressure prevailed to the northeast of the cyclone, forcing Sean to move slowly toward the west-northwest and then northward for the next 24-36 h. During that time, Sean intensified a little more when a ring of convection developed around an eye-like feature, and Sean reached its peak intensity of 55 kt and 982 mb at 1200 UTC 10 November. By then, Sean had turned toward the north-northeast ahead of an approaching trough and increased its forward speed. An increase in shear induced by the approaching trough, along with cooler waters, resulted in Sean's weakening early on 11 November.

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[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.

The center of Sean passed about 75 n mi to the west-northwest of Bermuda at 1200 UTC 11 November and at that point, the circulation was becoming elongated ahead of an approaching frontal system. By 0000 UTC 12 November, Sean had become a post-tropical cyclone, and 24 h later it dissipated when it merged with a cold front in the northeastern Atlantic.

b.   Meteorological Statistics

Observations in Sean (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), as well as flight-level, stepped frequency microwave radiometer (SFMR), and observations from one flight into the system by the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command on 10 November. Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU) instrument, NASA's Tropical Rainfall Measuring Mission (TRMM), the European Space Agency's ASCAT, the U.S. Navy's WindSat, and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Sean.

Ship reports of winds of tropical storm force associated with Sean are given in Table 2.

The marine operations center in Bermuda reported sustained surface winds of 37 kt and a wind gust to 54 kt near 0900 UTC 11 November as the center of Sean passed close to the island. NOAA data buoy 41047 was very instrumental in the evaluation of the intensity and wind radii of Sean.

Although visible satellite imagery showed an eye-like feature during most of the day on 9 November, which is typical of cyclones of hurricane intensity, the surrounding convection was not strong enough to classify the system as a hurricane using the Dvorak technique. A lower intensity estimate was also supported by data from a concurrent reconnaissance aircraft, which reported maximum surface winds of only 52 kt.

c.   Casualty and Damage Statistics

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

d.   Forecast and Warning Critique

Although the formation of Sean was first mentioned in the Tropical Weather Outlook about 54 h before genesis, a high probability of formation of a subtropical or tropical cyclone was not stated until 1800 UTC 7 November. This was only 12 h before the formation of the cyclone.

A verification of NHC official track forecasts for Sean is given in Table 3a. Official forecast track errors were lower than the mean official errors for the previous 5-yr period except at 12 h. Sean was potentially a difficult cyclone to forecast as evidenced by the very large

climatology-persistence (OCD5) errors; these OCD5 numbers were almost three times the official errors. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. The homogeneity requirement was relaxed in this case since most of the models had limited availability for Sean. The official track forecast errors were in general lower than most of the model errors.

A verification of NHC official intensity forecasts for Sean is given in Table 4a. Official intensity errors at all forecast times were lower than 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. As in the case of the track forecast for Sean, the official intensity forecast errors were in general lower than the model errors, and particularly so at 36 and 48 h.

The Bermuda Weather Service issued a tropical storm watch at 1200 UTC 8 November and replaced it with a tropical storm warning at 0900 UTC 9 November. The warning was discontinued at 2100 UTC 11 November.

Table 1. Best track for Tropical Storm Sean, 8-11 November 2011.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
06 / 0000	28.5	70.0	1005	45	extratropical
06 / 0600	28.5	69.2	1005	45	"
06 / 1200	28.4	68.8	1005	45	"
06 / 1800	28.0	68.5	1005	45	"
07 / 0000	27.9	68.6	1005	45	"
07 / 0600	27.7	68.7	1005	40	"
07 / 1200	27.5	69.0	1005	40	"
07 / 1800	27.6	69.3	1004	40	low
08 / 0000	27.6	69.6	1003	40	"
08 / 0600	27.7	69.8	1002	40	subtropical storm
08 / 1200	27.8	70.0	1000	45	"
08 / 1800	27.8	70.0	999	45	tropical storm
09 / 0000	27.8	70.1	999	45	"
09 / 0600	27.8	70.2	996	50	"
09 / 1200	27.9	70.4	994	55	"
09 / 1800	28.3	70.6	991	55	"
10 / 0000	29.0	70.7	987	55	"
10 / 0600	29.7	70.9	984	55	"
10 / 1200	30.2	70.7	982	55	"
10 / 1800	30.5	70.0	983	55	"
11 / 0000	31.0	69.0	984	55	"
11 / 0600	32.2	67.2	987	50	"
11 / 1200	33.4	65.3	991	45	"
11 / 1800	34.8	62.6	995	40	"
12 / 0000	35.9	59.4	1000	35	extratropical
12 / 0600	38.0	57.2	1000	35	"
12 / 1200	40.0	55.0	1000	35	"
12 / 1800	42.5	52.4	1000	35	"
13 / 0000					absorbed
10 / 1200	30.2	70.7	982	55	minimum pressure

Table 2.   Selected ship and buoy reports with winds of at least 34 kt for Tropical Storm Sean 8 -11 November 2011.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
09 / 0350	41047	27.5	71.5	340 / 35	1000.6
09 / 0800	9HA258	25.0	67.5	220 / 42	1008.0
09 / 1900	PHET	26.9	67.0	180 / 49	1003.0
10 / 1150	41048	32.0	69.6	100 / 35	999.5
10 / 1800	9HXC9	27.2	66.7	200 / 35	1006.5
11 / 0900	C6FZ7	32.5	74.4	310 / 38	1010.0

Table 3a.   NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Sean, 8-11 November 2011. Mean errors for the 5-yr period 2006-10 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	35.6	**42.7**	**60.9**	**69.3**	**82.7**	**45.3**	
OCD5	54.0	90.5	151.2	236.2	433.4	610.5	
Forecasts	16	11	10	9	6	2	
OFCL (2006-10)	31.0	50.6	69.9	89.5	133.2	174.2	
OCD5 (2006-10)	47.7	98.3	156.4	218.1	323.3	402.2	

Table 3b.   Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Sean, 8-11 November 2011. 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	18.2	36.5	39.9	54.4			
OCD5	46.4	76.3	105.3	215.5			
TVCC	19.5	36.9	53.3	137.7			
TVCE	21.0	**36.4**	56.5	146.8			
TVCA	19.9	38.2	59.7	155.1			
FSSE	22.7	44.3	40.8	74.5			
AEMI	**17.8**	37.9	43.9	79.3			
CMCI	65.7	93.9	142.6	318.4			
NGPI	28.7	61.5	87.8	178.6			
HWFI	22.8	40.7	49.4	94.2			
GHMI	25.2	71.9	165.2	451.8			
GFSI	20.0	40.3	**38.8**	54.8			
BAMD	40.3	65.8	61.7	159.8			
BAMM	40.2	70.1	71.0	164.7			
BAMS	50.4	109.9	155.6	201.4			
NAMI	26.4	70.8	154.1	356.6			
Forecasts	10	8	7	7			

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Table 4a.   NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Sean, 8-11 November 2011. Mean errors for the 5-yr period 2006-10 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	**5.3**	**8.2**	**7.5**	**7.8**	**7.5**	**2.5**	
OCD5	4.3	6.7	9.2	10.8	11.8	15.5	
Forecasts	16	11	10	9	6	2	
OFCL (2006-10)	7.2	11.0	13.2	15.1	17.2	17.9	
OCD5 (2006-10)	8.5	12.3	15.4	17.8	20.2	21.9	

Table 4b.　　Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Sean, 8-11 November 2011. 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.

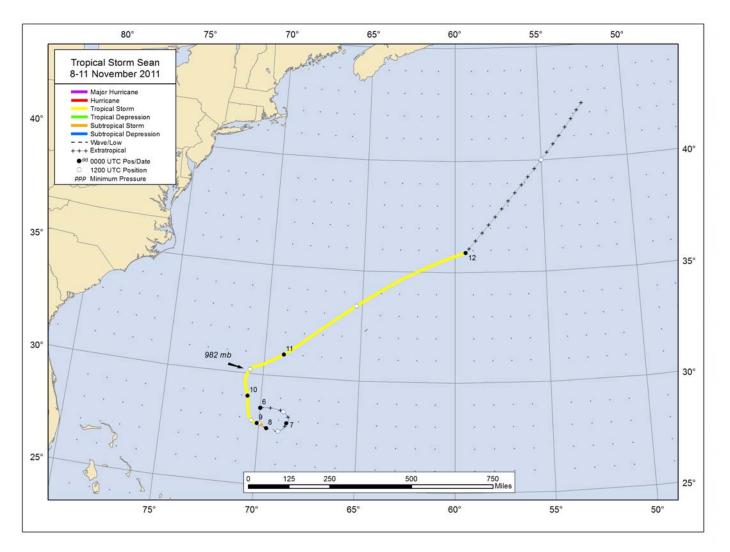| Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	4.1	8.5	7.2	7.1			
OCD5	**3.9**	**6.8**	9.2	10.0			
DSHP	**3.7**	**6.3**	8.9	10.0			
LGEM	4.2	**7.5**	10.3	11.0			
GHMI	6.5	10.5	11.9	16.0			
HWFI	5.5	9.1	10.8	11.7			
FSSE	6.5	11.1	14.3	15.9			
IVCN	4.7	**7.1**	9.9	10.4			
ICON	4.7	**7.2**	9.9	11.9			
Forecasts	11	10	9	7			

Figure 1.   Best track positions for Tropical Storm Sean, 8-11 November 2011. Track during the extratropical stage is partially based on analyses from the NOAA Ocean Prediction Center.
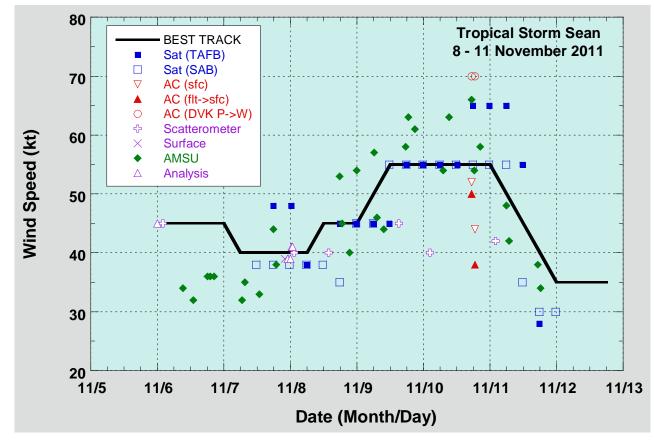
Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Sean, 8-11 November 2011. Aircraft observations have been adjusted for elevation using 90%, 80%, and 80% adjustment factors for observations from 700 mb, 850 mb, and 1500 ft, respectively. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC.
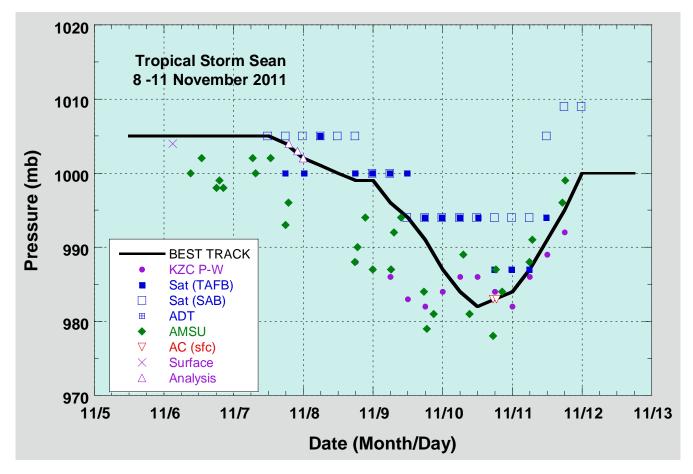
Figure 3.   Selected pressure observations and best track minimum central pressure curve for Tropical Storm Sean, 8-11 November 2011. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. The KZC P-W values are obtained by applying the Knaff-Zehr-Courtney pressure-wind relationship to the best track wind data. Dashed vertical lines correspond to 0000 UTC.