

Tropical Cyclone Report
Hurricane Karen
(AL122007)
25-29 September 2007

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Karen was briefly a hurricane over the tropical Atlantic. It did not threaten land, and it dissipated just to the east of the Leeward Islands.

a. Synoptic History

A tropical wave emerged from western Africa on 21 September accompanied by only a few showers and thunderstorms, but with a large envelope of low pressure at low latitudes. As the system continued westward over the next couple of days, there was an increase in the associated deep convection and a broad low-level circulation gradually became better-defined. Curved banding features soon became evident, and Dvorak classifications were initiated early on 23 September while the disturbed weather area was located about 550 n mi south of the Cape Verde Islands. The system moved west-northwestward with little change in organization until late on 24 September, when convective banding features became well-enough defined to designate the formation of a tropical depression centered about 720 n mi west-southwest of the Cape Verde Islands at 0000 UTC 25 September. Strengthening into a tropical storm occurred about 6 h thereafter. The “best track” chart of Karen’s path is shown in Fig. 1, with the wind and pressure histories displayed in Figs. 2 and 3, respectively. The best track positions and intensities are listed in Table 1.

For about a day after its formation, there was only a slight increase in the cyclone’s organization and intensity. Early on 26 September, however, Karen’s cloud signature became much better organized, and it strengthened significantly. The cyclone reached hurricane strength, and its peak intensity of about 65 kt, by 1200 UTC 26 September. Later that day, a sharp upper-level trough to the west of Karen produced a substantial increase in southwesterly vertical shear over the hurricane. Karen quickly lost organization, and it weakened below hurricane status by 0000 UTC 27 September. Later that same day, as southwesterly shear continued to impact the tropical cyclone, the low-level circulation center became exposed to the west and southwest of the deep convection. Karen continued to gradually weaken in an unfavorable upper-level wind environment, and diminished to marginal tropical storm intensity on 28 September. Meanwhile, Karen’s heading changed temporarily from west-northwestward to northward, perhaps due to changes in the convective involvement of the low-level center or to a temporary surge of low-level environmental southerlies. Although intermittent bursts of deep convection occurred near the center, the relentless southwesterly shear caused further weakening. By early on 29 September, Karen weakened to a tropical depression and turned westward in response to the low-level easterly environmental flow. After 1200 UTC 29 September, Karen’s circulation became so distorted that the system could no longer be tracked, indicating dissipation.

A remnant area of showers and squalls lingered near and east of the Leeward Islands for a few more days.

b. Meteorological Statistics

Observations in Karen (Figs. 2 and 3) include 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 and Stepped-Frequency Microwave Radiometer (SFMR) measurements from two NOAA Hurricane Hunter aircraft missions. Data and imagery from NOAA polar-orbiting satellites, the NASA Tropical Rainfall Measuring Mission (TRMM), the NASA QuikSCAT, and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in tracking Karen.

Karen's maximum intensity was estimated operationally to be 60 kt, corresponding to a strong tropical storm. Post-storm analysis of the data, however requires a slight increase in the best track intensity. A NOAA Hurricane Hunter mission measured peak 700 mb flight-level winds of 69 kt and SFMR surface winds of 62 kt shortly before 0000 UTC 27 September. These data support an intensity of 60 kt. By the time of the aircraft observations, however, Karen's appearance on satellite imagery was decidedly less-organized than it was 6 to 12 h earlier (Fig. 4). Around 1200 UTC 26 September, the imagery showed significantly better-defined banding features than the imagery from about 12 h later. Moreover, a visible satellite picture taken near 1200 UTC 26 September (Fig. 5) showed a faint eye-like feature. It is therefore estimated that Karen was a 65-kt hurricane at 1200 and 1800 UTC on 26 September. This is also consistent with Dvorak intensity estimates from TAFB at those times, which were based on the measurement of a banding feature that wrapped entirely around the center (Note: the possibility that a post-storm upgrade would be required was noted in the National Hurricane Center Tropical Cyclone Discussion product issued when the aircraft data arrived).

NOAA data buoy 41041, located at 14.5°N 46.0°W (sensor elevation 5 m), reported a maximum 1-minute wind of 43 kt at 0700 UTC 27 September, at which time the center of Karen was located about 75 n mi to the south. No ship reports of tropical storm force winds associated with Karen were received.

c. Casualty and Damage Statistics

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

d. Forecast and Warning Critique

Karen's formation was well anticipated. The tropical wave and accompanying broad area of low pressure that eventually developed into Karen, and the possibility of slow development, were first mentioned in the Tropical Weather Outlook (TWO) nearly 57 h before genesis. The next TWO, issued nearly 51 h prior to genesis, indicated the potential for tropical depression formation over the ensuing few days. Subsequent TWOs leading up to Karen's formation were more emphatic about genesis.

A verification of official and guidance model track forecasts is given in Table 2. Average official track errors for Karen were 52, 72, 96, 106, 142, and 186 n mi for the 12, 24, 36, 48, 72, and 96 h forecasts, respectively. The number of forecasts ranged from 16 at 12 h to 2 at 96 h. There were no forecasts that verified out to 120 h. These track forecast errors are a little higher than the average long-term official track errors at 12 through 36 h and somewhat lower than the average long-term official track errors at 48 through 96 h (Table 2).

Average official intensity errors were 6, 11, 13, 15, 22, and 25 kt for the 12, 24, 36, 48, 72, and 96 h forecasts, respectively. For comparison, the average long-term official intensity errors are 6, 10, 12, 14, 18, and 20 kt, respectively. Table 3 gives a verification of official and guidance model intensity forecasts. There was somewhat of a high bias in the official intensity forecasts, but the official forecasts were generally correct in anticipating that Karen's strengthening would be limited or halted by increasing shear. That increase of shear ahead of the tropical cyclone was rather well predicted a few days in advance by the NCEP Global Forecast System and other global models.

Table 1. Best track for Hurricane Karen, 25-29 September 2007.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
25 / 0000	10.0	35.9	1006	30	tropical depression
25 / 0600	10.3	37.0	1005	35	tropical storm
25 / 1200	10.6	38.0	1005	35	"
25 / 1800	10.8	39.2	1005	35	"
26 / 0000	10.9	40.4	1003	40	"
26 / 0600	11.2	41.5	997	50	"
26 / 1200	11.7	42.4	988	65	hurricane
26 / 1800	12.3	43.3	990	65	"
27 / 0000	12.8	44.6	995	60	tropical storm
27 / 0600	13.2	45.7	998	55	"
27 / 1200	13.5	46.8	1002	55	"
27 / 1800	14.1	47.9	1005	50	"
28 / 0000	14.1	48.8	1005	50	"
28 / 0600	14.3	49.0	1007	40	"
28 / 1200	14.6	49.0	1008	35	"
28 / 1800	15.8	49.4	1008	35	"
29 / 0000	16.1	51.0	1008	35	"
29 / 0600	16.3	52.6	1008	30	tropical depression
29 / 1200	16.8	54.2	1009	30	low
29 / 1800					dissipated
26 / 1200	11.7	42.4	988	65	minimum pressure

Table 2. Preliminary track forecast evaluation (heterogeneous sample) for Hurricane Karen, 25-29 September 2007. Forecast errors (n mi) are followed by the number of forecasts in parentheses. Errors smaller than the NHC official forecast are shown in bold-face type. Verification includes the depression stage.

Forecast Technique	Forecast Period (h)						
	12	24	36	48	72	96	120
CLP5	57 (15)	72 (13)	74 (11)	85 (9)	139 (6)	202 (2)	
GFNI	67 (12)	76 (10)	93 (8)	129 (6)	223 (2)		
GFDI	49 (16)	83 (14)	110 (12)	131 (10)	162 (6)	222 (2)	
HWFI	60 (16)	93 (14)	113 (12)	125 (10)	186 (6)	281 (2)	
GFSI	65 (13)	97 (11)	132 (9)	146 (7)	161 (3)	161 (1)	
AEMI	61 (5)	101 (5)	131 (5)	146 (5)	236 (4)	232 (1)	
NGPI	57 (14)	66 (12)	90 (10)	113 (8)	199 (4)	341 (2)	
UKMI	50 (15)	53 (13)	76 (11)	78 (9)	100 (5)	78 (1)	
BAMD	50 (16)	68 (14)	92 (12)	121 (10)	215 (6)	302 (2)	
BAMM	53 (16)	71 (14)	86 (12)	105 (10)	169 (6)	190 (2)	
BAMS	78 (16)	147 (14)	211 (12)	263 (10)	356 (6)	366 (2)	
CONU	50 (16)	67 (14)	89 (12)	101 (10)	114 (6)	121 (2)	
GUNA	56 (11)	72 (9)	99 (7)	107 (5)	86 (1)	153 (1)	
FSSE	54 (13)	64 (11)	70 (9)	69 (7)	120 (4)		
OFCL	52 (16)	72 (14)	96 (12)	106 (10)	142 (6)	186 (2)	
NHC Official (2002-2006 mean)	35 (1852)	61 (1686)	86 (1519)	112 (1362)	162 (1100)	221 (885)	290 (723)

Table 3. Preliminary intensity forecast evaluation (heterogeneous sample) for Hurricane Karen, 25-29 September 2007. Forecast errors (kt) are followed by the number of forecasts in parentheses. Errors smaller than the NHC official forecast are shown in bold-face type. Verification includes the depression stage.

Forecast Technique	Forecast Period (h)						
	12	24	36	48	72	96	120
SHF5	9.1 (15)	16.5 (13)	21.9 (11)	20.7 (9)	21.5 (6)	28.5 (2)	
GHMI	7.6 (16)	11.7 (14)	16.3 (12)	16.6 (10)	23.7 (6)	34.5 (2)	
HWFI	7.6 (16)	8.5 (14)	10.3 (12)	12.3 (10)	18.8 (6)	31.5 (2)	
SHIP	7.8 (16)	11.9 (14)	13.3 (12)	18.0 (10)	28.8 (6)	41.0 (2)	
DSHP	7.8 (16)	11.9 (14)	13.3 (12)	18.0 (10)	28.8 (6)	41.0 (2)	
FSSE	9.1 (13)	14.5 (11)	16.7 (9)	17.9 (7)	18.8 (4)		
ICON	6.8 (16)	10.1 (14)	12.9 (12)	13.9 (10)	23.0 (6)	40.0 (2)	
OFCL	5.6 (16)	11.4 (14)	12.9 (12)	14.5 (10)	21.7 (6)	25.0 (2)	
NHC Official (2002-2006 mean)	6.4 (1852)	9.8 (1686)	12.0 (1519)	14.1 (1362)	18.3 (1100)	19.8 (885)	21.8 (723)

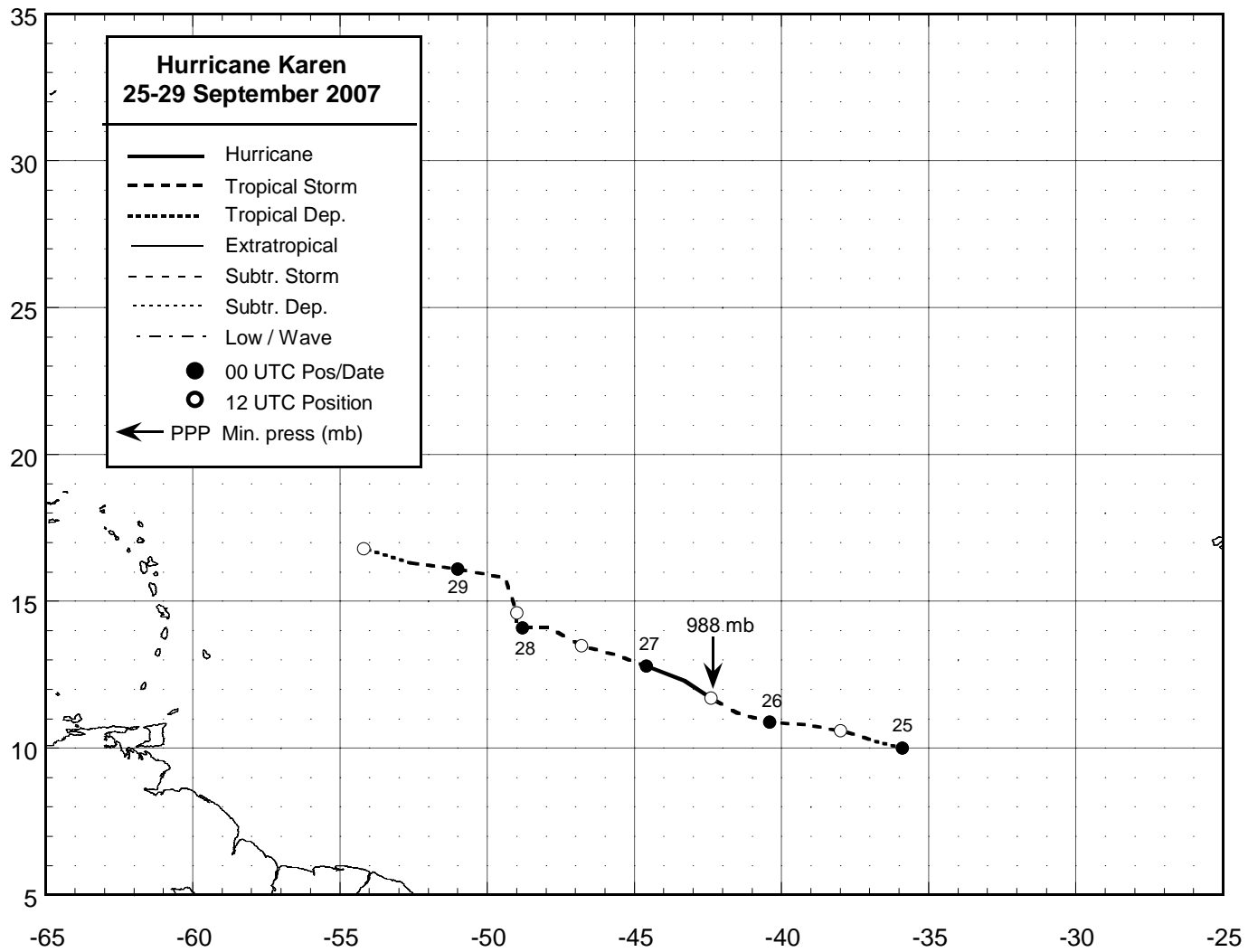


Figure 1. Best track positions for Hurricane Karen, 25-29 September 2007.

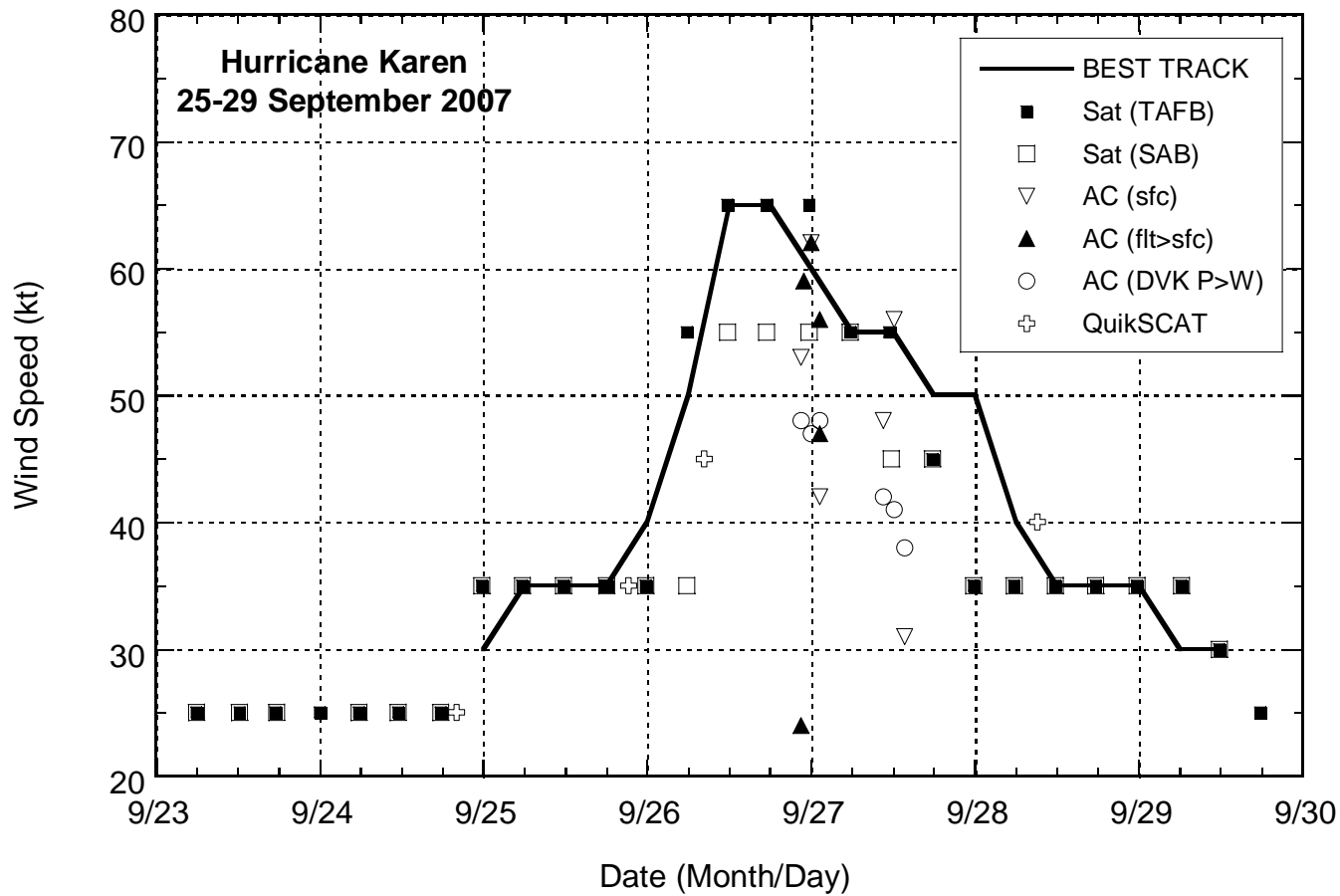


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Karen, 25-29 September 2007. Aircraft observations have been adjusted for elevation using 90%, 80%, and 80% reduction factors for observations from 700 mb, 850 mb, and 1500 ft, respectively.

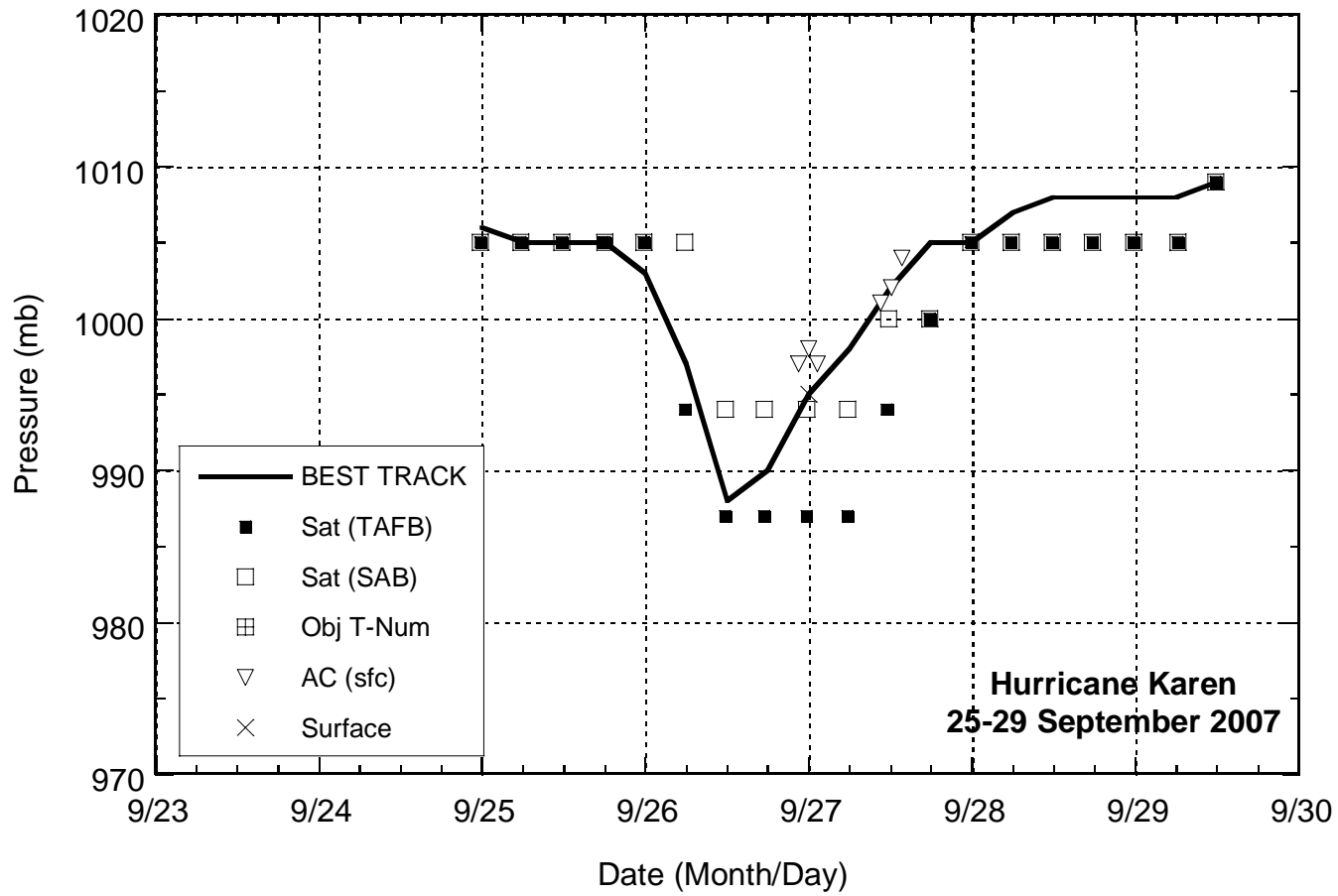


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Karen, 25-29 September 2007.

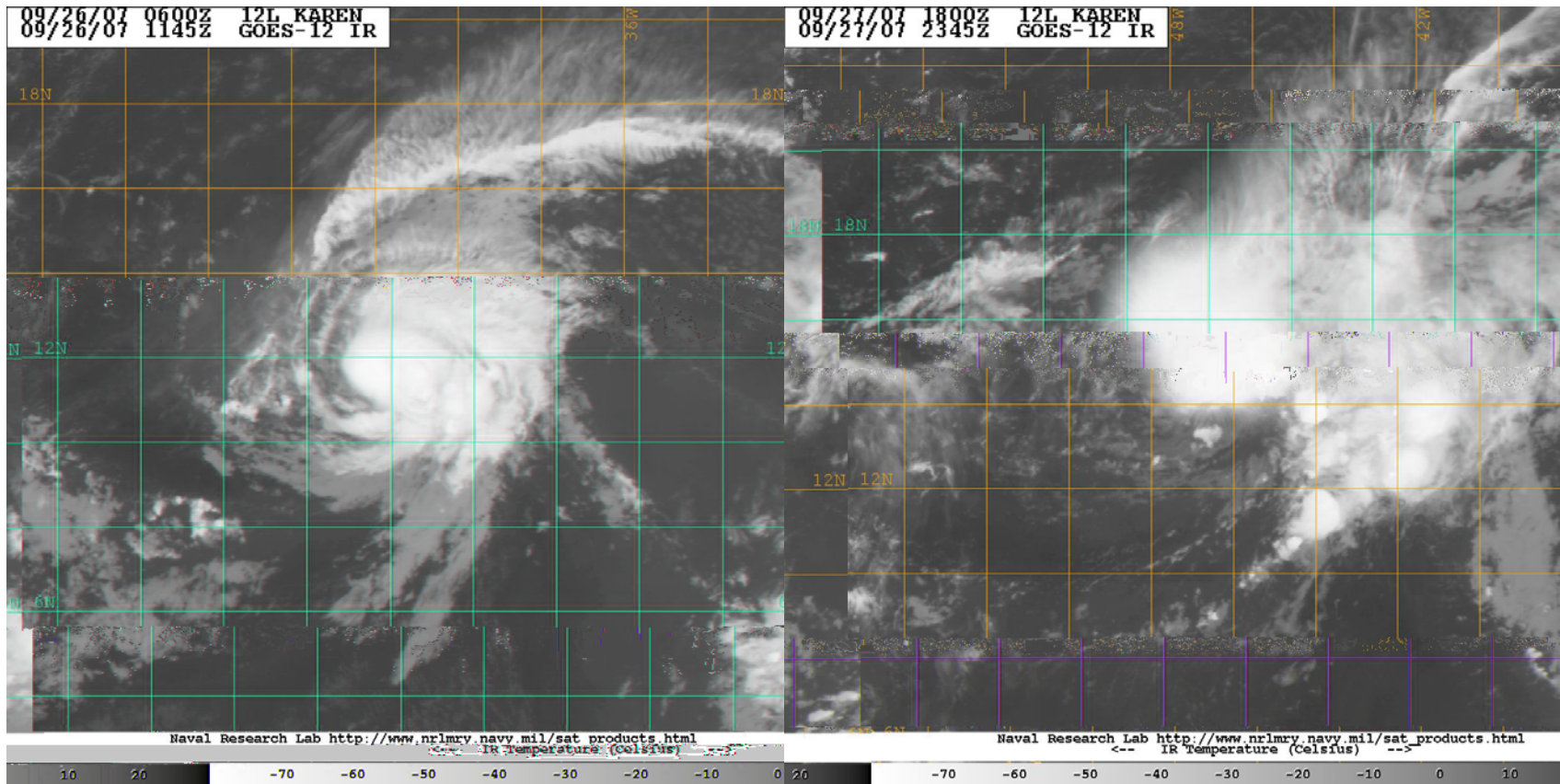


Figure 4. Infrared satellite image of Karen at 1145 UTC 26 September 2007 (left), and 2345 UTC 27 September (right). Images are from the Naval Research Laboratory Tropical Cyclone page.

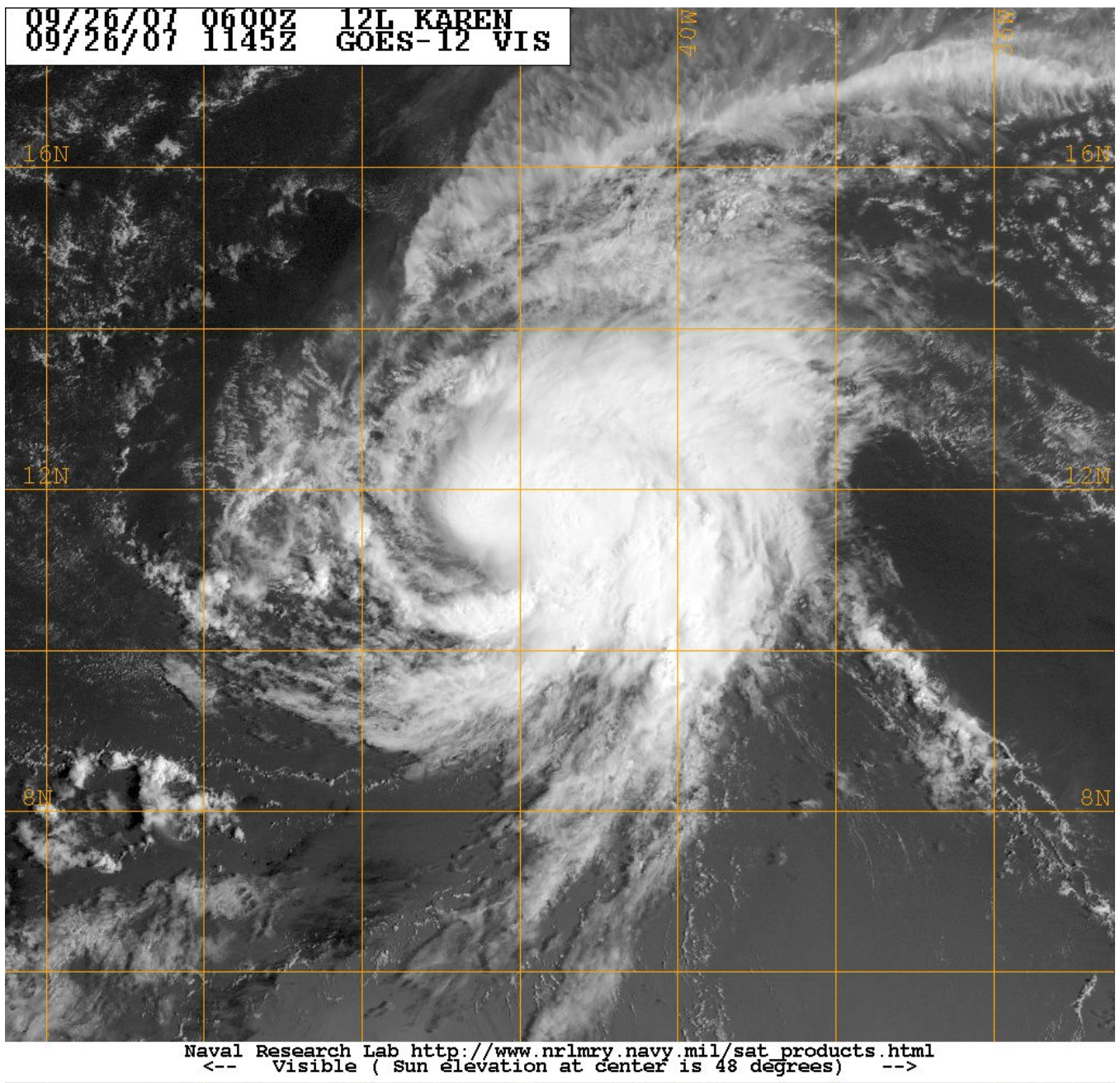


Figure 5. Visible satellite image of Karen at 1145 UTC 26 September 2007. Image is from the Naval Research Laboratory Tropical Cyclone page.